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Nationalising and Rationalising

Unless nationalisation be synonymous with rationalisation it is bound to fail. So far, people are apt to be paying more attention to the financial showing of the State monopolies, but, though in the case of the Coal Board the losses have been very heavy, we deem the period too short to attach too much importance to this, and believe it wise to consider the more technical aspects. Before us we have "A review on the Industrial and Economic Situation during 1947 in Poland," issued by the Board of Trade, dealing with the nationalised textile industries. From it we cull the following statements as relating to rationalisation. "It is doubtful if the groupings and amalgamations of textile plants undertaken during the past year have brought any gains to the industry." "Centralisation has only increased the difficulties of obtaining the necessary raw materials, dyes, *etc.*, at the mills, since the central authority has not the intimate experience of each individual factory's wants and difficulties," and finally "In many cases types of cotton or wool have been delivered to a mill, the machinery of which is unsuitable for the processing of that particular quality. This has caused extra transport and often even stoppages at the plant."

Now turning to Czechoslovakia, where the metallurgical industries became a State monopoly immediately after the liberation, we learn the following conditions exist. The financial loss of these industries up to the end of 1947 was of the order of £350 millions—a very high figure for a comparatively small manufacturing country, and one which would adversely affect the financial standing of much larger states. With the nationalisation of the industry, from each concern was demanded a certain production—now usually and ridiculously known as a "target." The outcome of this was that the foundries made the heavier types of casting with less rigorous inspection. The nail makers produced the maximum of the largest sizes of moulders' brads, so short ones must be made by cutting them down on the shop floor to the lengths required. This type of production is not rational, but statistically the result may read well, when one learns that a plant has surpassed the required production by a certain percentage.

Then, there is this question of State buying. The case of textiles in Poland, if applied to the British ironfounders, makes it easy to see the effect of the delivery of low phosphorus pig-iron to a stove grate maker. After all, in the mind of the uninitiated pig iron is pig iron, and it would be the job of a centralised body to see that this commodity was supplied to the consumer in appropriate shares. Of course, none of these happenings is rational, but they are to be associated with the physical results of the nationalising of manufacturing industries.

Whilst the examples we have quoted are from overseas, there is no reason to believe that they are in any way exotic. They represent the conditions which can be truthfully associated with the creation of state monopolies in any country. Executive officers in industry must satisfy the policy enunciated by the higher authorities. If it be, as under private enterprise, to contribute their quota towards the profit account or, as under a state monopoly, to achieve a predetermined production, the good manager will always succeed. The cardinal difference is that the former has to be profitable—in every sense of the word—production, otherwise the manager will be looking for a new job.

Contents

Nationalising and Rationalising, 189.—The Maurer Diagram and its Evolution and A New Structural Diagram for Cast Iron, 191.—Nodular Cast Irons, their Production and Properties, 199.—Repetition Pattern Making, 201.—Association Technique de Fonderie, 203.—Pig-iron and Steel Production in Great Britain, 204.—Personal, 205.—British Exhibition in Copenhagen, 205.—Company News, 206.—News in Brief, 207.—Metal Industries' Ordinary Stock, 207.—Shipbuilders' Steel Allocations, 207.—Gazette 207.—Increases of Capital, 208.—Contracts Open, 208.—Obituary, 209.

National Foundry College

The new session of the National Foundry College will begin at the Technical College, Wolverhampton, on September 27, 1948. Intending applicants should apply to the Head of the College, Mr. J. Bamford, B.Sc., for forms of admission. Candidates with suitable practical experience and technical knowledge will be admitted direct to this full-time diploma course, which will end in July, 1949. A minimum of one year's practical experience is required in the founding industry, together with an appropriate university degree, or Higher National Certificate, coupled in the case of the latter with a record of additional study, or special responsibility, or informative industrial experience.

Modified Scheme

Experience has shown that some candidates require more preparation, particularly where the major technical colleges are not readily accessible to them. For these, a preliminary course, of six months' duration, to be called Part I of the Diploma Course, will be arranged to begin in January, 1949. The present Diploma Course will become Part II, and the intervening period between the end of Part I in June, 1949, and the beginning of Part II in the following September can be spent in acquiring foundry experience. Normally, Part I and Part II will in future begin at the same time in September of each year, and run concurrently, thus allowing to those students who take both parts an interval of six months between Part I and the beginning of the succeeding Part II to be spent in acquiring foundry experience, which will count towards the practical experience required for admission to Part II. However, it will not be essential for students to take Part II immediately following Part I; thus, for example, 18 months may elapse instead of six months between the two sections of the course.

Registration Details

It is anticipated that candidates whose technical knowledge in the past has not been adequate to admit them to Part II will be able to equip themselves sufficiently through Part I, but those with suitable qualifications will be admitted direct to Part II. Candidates who are in doubt as to which part of the course their experience and qualifications entitle them to register are advised to apply to the Head of the College. Every application will be treated on its merits and the most suitable course recommended. As previously, it is anticipated that many candidates will be sponsored by their employers in all branches of the industry—cast iron, malleable iron, steel, brass, bronze and aluminium alloys. The fee for Part I is £40 for the session and the fee for Part II is £60 for the session. The Board of Governors may remit fees for all those candidates whose employers belong to a trade association giving financial and other support to the College.

It is hoped that a hostel will be available in September, 1949, or as soon as possible thereafter, for students of the College registering for the new session.

Machine Tool and Engineering Exhibition

The Machine Tool and Engineering Exhibition, which opens to-day at Olympia, is the first of its kind to be held in London since 1934. It is organised by the Machine Tool Trades Association, Inc., and the space covered by the stands, numbering nearly 300, occupies the whole of the "Grand," "Empire" and "National" halls, together with the two galleries.

Two aspects of the exhibition have major interest for foundrymen. First, about one-third of the exhibitors are themselves founders and castings are on view as part of most of the finished machine tools and, second, foundrymen are increasingly becoming users of machine tools—grinders, saws, cutting-off machines, woodworking machinery, lathes and so on—and are therefore potential buyers. Machine-tool makers probably represent one of the largest "value" as well as "tonnage" markets for makers of castings. Modern trends of design and extension of, or discontinuance of, the use of castings in the period since 1934 will offer wide dispersion of interest. The equipment and service sections of the machine-tool trade are well represented and makers of such items as furnaces, compressors, grinding wheels and the like will have complementary attraction for our own industry's representatives.

The exhibition is open on weekdays from 10.30 a.m. to 6.30 p.m., and closes on September 11.

Forthcoming Events

(Secretaries are invited to send in notices of meetings, etc., for inclusion in this column.)

SEPTEMBER 1.
Manchester Association of Engineers.
Visit to the Manchester Docks and Ship Canal. Assembly at dock entrance in Trafford Road at 2.30 p.m.

SEPTEMBER 2.
Institute of Vitreous Enamellers.
Midland Section:—"Metal for Enamelling," by E. Marks, at the Chamber of Commerce, New Street, Birmingham, at 7.15 p.m.
Institution of Production Engineers.
Nottingham Section:—Visit to the Standard Motor Company's Tractor Factory. Assemble at Banner Lane factory at 12 noon.

THE INTERNATIONAL MEEHANITE METAL COMPANY, LIMITED, announce that licences to manufacture castings by the Meehanite Process have been granted to the following firms:

Goulds Mechanisations, Limited, Tredegar Foundry, Newport, Mon.

Ansaldo, Societa per Azioni, Genova-Sestri, Italy.

Franco Tosi, S.P.A., Legnano, Italy.

Cie. des Forges et des Fonderies de la Marine et d'Homecourt, St. Chamond, Loire, France.

Netherlands Dock & Shipbuilding Company, Amsterdam, Holland.

Ijzer-en Metaalgieterij, "De Globe," Tegelen, Holland.

A/S. Atlas Maskinfabrik, Copenhagen, Denmark.

A/S. Burmeister & Wain's, Copenhagen, Denmark.

Aktiebolaget Limhamns Aduceringsverk, Malmo, Sweden.

Exchange Paper from the "Association Technique de Fonderie"

The Maurer Diagram and its Evolution and A New Structural Diagram for Cast Iron*

A Review of Constitutional Diagrams for Cast Iron

By H. Laplanche, Docteur ès Sciences, Ingénieur-Métallurgiste

INTRODUCTION

In order fully to understand what follows, it is as well to recall briefly a certain number of generalities relative to various micrographic structures observed in cast irons and their incidence on the properties of these alloys, particularly on their mechanical characteristics.

The various micrographic structures of cast iron.

It is known that the whole range of irons, as cast, can be divided into three groups according to the appearance of the fracture: (1) Iron with a completely white fracture, or "white irons"; (2) irons with a black fracture; and (3) irons with a fracture intermediate between the first two, these being those with a grey fracture, "grey iron" and those with a mottled fracture, "mottled iron."

(1) White irons are those in which the whole of the carbon is present in the metastable state, that is, as combined carbon, in the form of carbide or cementite, more or less complex, and of which the chemical composition is a function of the nature and the proportions of the elements contained in the alloy. The cementite can be present in the following different forms:—(*a*) hyper-eutectic cementite; (*b*) eutectic cementite; (*c*) hyper-eutectoid cementite, and (*d*) eutectoid cementite.

As cementite is hard and brittle, the white irons are themselves all the more hard and brittle as the proportion of cemenite increases, that is, as the carbon content is higher. Their fracture shows reflecting facets and passes progressively to a granular steely fracture as the carbon content decreases, other things being equal.

Further, it is known that white irons can be malleabilised by an appropriate annealing, according to their chemical composition. After full annealing, a completely transformed structure is obtained in which the whole, or only a part of the carbon, is found in the free state, crystallised in the form of nodular graphite. The fracture then becomes black, always provided that the final cooling takes place in air from 650 deg. C. This black silky fracture is always obtained when the structure of a cast iron contains only ferrite and graphite, whatever the form in which the graphite is present.

(2) When the whole of the carbon present is found in the stable condition, that is to say, in the crystalline or graphitic state, the matrix is obviously wholly ferritic and the fracture is black, as mentioned above. The graphite formed during solidification is, however, lamellar or punctiform.

(3) The intermediate cast irons can be sub-divided as follows:—

(*a*) The irons commonly called "grey" are in fact those in which the euctectic carbon at least (and the hyper-eutectic carbon, if any be present) is in the form of graphite, lamellar or punctiform. The hyper-eutectoid carbon can also be present in the form of graphite. On the other hand it is essential, to produce a grey fracture, for at least a part of the eutectoid carbon to be present in the metastable state in the pearlite.

(*b*) Irons in which the whole of the cementite, eutectic, hyper-eutectic and hyper-eutectoid is partially dissociated. The graphite and the cementite exist together throughout.

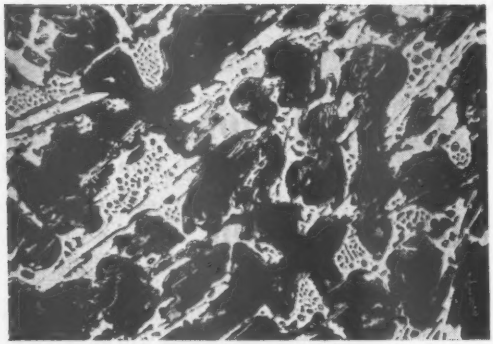
(*c*) Irons in which certain areas completely metastable (white) are mingled with entirely grey or entirely black areas. Only the irons of this category are properly called "mottled" irons. Their fracture does indeed show grey or black islets on a white background, or white patches on a grey or black background, according to whether the preponderant matrix is white or graphitic.

The microphotographs of Fig. 1 show these various structures:— Fig. 1 (*a*), completely white iron, nital etched 4, × 200, category (1) (*a*), and Fig. 1 (*b*), completely black iron, nital etched 4, category (2); Fig. 1 (*c*), grey iron with completely pearlite matrix, category 3 (*a*); Fig. 1 (*d*) grey iron, with pearlite-ferrite matrix, category 3 (*a*); Fig. 1 (*e*) iron with cementite partly transformed into graphite throughout category 3 (*b*), and Fig. 1 (*f*) mottled cast iron, with grey zones forming islets in a white matrix, etched Stead, category 3 (*c*).

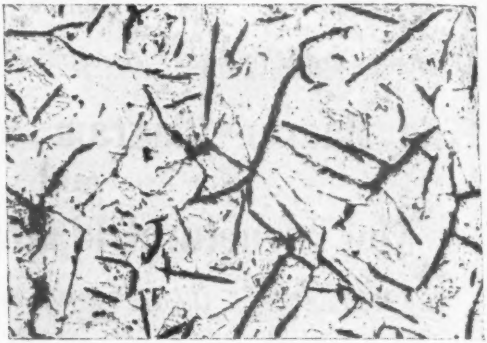
In addition, the three micrographs of Fig. 2 show, without the etching of the matrix, three typical forms of graphite respectively:—Fig. 2 (*a*), graphite in a hyper-eutectic cast iron × 50; Fig. 2 (*b*) graphite in a hypo-eutectic cast iron × 100; and Fig. 2 (*c*), graphite-punctiform or eutecticform in super-cooled cast iron × 500.

It follows from the above that a graphitic cast iron is formed of a steel matrix split up by graphite. If

*Presented to the London Conference of the Institute of British Foundrymen, June, 1948.



(*a*) White Cast Iron.

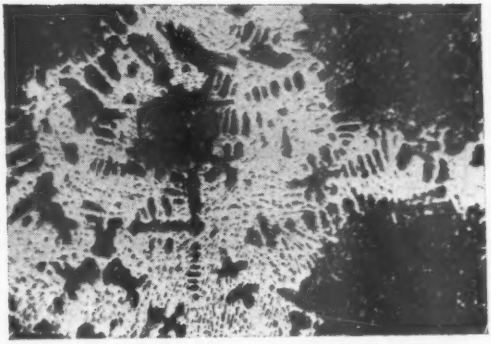


(*b*) Cast Iron with Black Fracture (Graphite Flakes in Ferrite Matrix).

(*c*) Pearlitic Cast Iron.

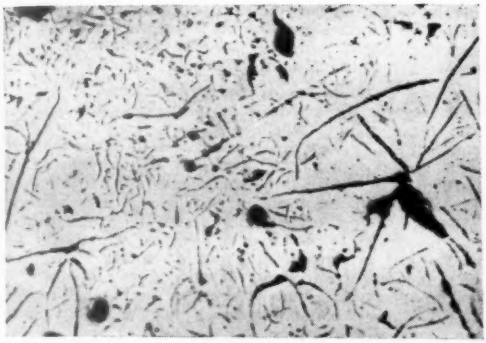
(*d*) Cast Iron with Pearlite Ferrite Matrix.

(*e*) Matrix with Graphite and Cementite Interposed.

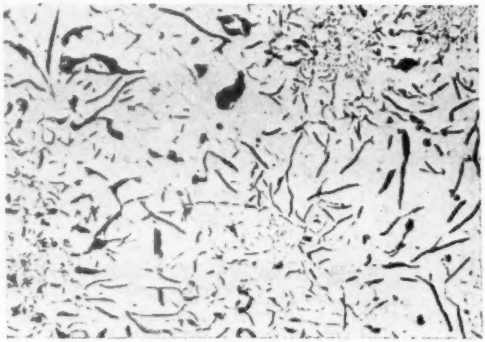


(*f*) Mottled Cast Iron (Grey islets in White Iron).

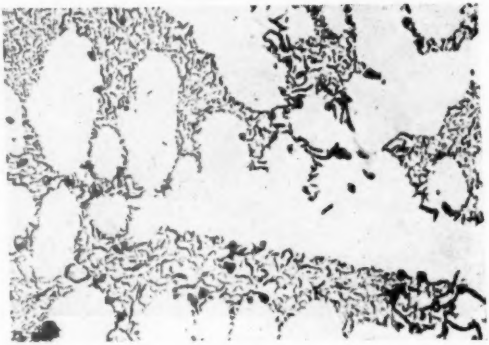
FIG. 1.—VARIOUS STRUCTURES OF CAST IRON, ALL ×200 MAGNIFICATIONS. ALL ETCHED IN NITAL WITH THE EXCEPTION OF (*f*), WHICH WAS ETCHED IN STEAD'S REAGENT.



(*a*) Magnification × 50, Unetched.



(*b*) Magnification × 100, Unetched.



(*c*) Magnification × 500, Unetched.

FIG. 2.—THREE NORMAL FORMS OF GRAPHITE IN CAST IRON AFTER SOLIDIFICATION.

the matrix be that of a dead mild steel, it yields cast iron with a black fracture. If the matrix be that of a hypo-eutectoid or eutectoid steel, it yields grey cast iron. (However, the distribution of the ferrite and the pearlite is not usually the same in a grey iron as in a hypo-euctectoid steel, as is shown on micrograph in Fig. 1 (*d*), where the ferrite can be seen to surround the graphite lamellæ.)

It is clear that when, for a given total carbon content, one passes progressively from a pure white iron to a black iron, with a completely ferritic matrix, the relation of the amounts of graphitic carbon to total carbon passes from 0 to 1. This proportion then gives *a priori* information on the structure which can be expected to be found in the matrix.

INFLUENCE OF STRUCTURE ON MECHANICAL PROPERTIES

Obviously the mechanical properties, which are only the expression of the structure on the mechanical side, are influenced by the structural factors relative to the graphite and those relative to the nature of the matrix.

Influence of Graphite

Graphite is a weakening element, and is known to have three distinct effects: [1, 2, 3, 4]

1. *Discontinuity in the metal.*—The particles of graphite form interruptions or breaks in continuity in the metal. Now the tensile strength of graphite is negligible, so that the section which effectively resists a tensile stress in a specimen is smaller than its apparent section casting. This reduction in area is of the order of 9 to 10 per cent. in the usual types of iron castings. It is clear that this effect depends chiefly on the proportion of the total graphite by volume.[6]

2. *Contraction of area effect.*—The tensile stresses in a piece of cast iron submitted to tensile tests, are obliged to pass round the graphite and along the metal bridges in the matrix, that is to say, to follow wavy lines, which has the effect of increasing the mean tension at each point of the metal for a given total stress. This effect depends largely on the size and the distribution of the graphite.[1, 2, 3, 5]

3. *Notch effect.*—Each small flake of graphite acts like a notch in the matrix, and it is known that stresses concentrate at the ends of notches, thus increasing the unit stress at those points. This effect depends chiefly on the shape of the lamellæ and especially on the taper at their ends.[1, 2, 3, 5]

These three effects explain the wide range observed in the results of mechanical tests on irons particularly in tensile tests.

It would seem from the above that, as regards the graphite, it is advisable, if it be desired to improve the tensile and transverse tests, to seek for the most finely divided graphite possible, that is in the punctiform state, or, failing that, that grouped in small spots, which each correspond to a eutectic cell. (Fig. 2, (*b*) and (*c*)).[6]

The modulus of elasticity shows up very clearly the influence of graphite in cast iron.[7, 8, 9] It varies, for the general run of cast iron, from six million lb. per sq. in., whereas the matrix of a corresponding steel without graphite would have a modulus of 19 to 22 million lb. per sq. in. Similarly, the tensile strength

Structural Diagrams for Cast Iron

of a grey iron is from 12 to 18 tons per sq. in., for instance, whereas that of a steel without graphite would be 36 to 48 tons per sq. in.

The importance of this morphology of graphite in cast iron has been brought to notice for a long time past. In 1927 Portevin[10] wrote: "A considerable new step forward will be made when there are means of acting with certainty on the structure of graphitic solidification by refining the graphite flakes and especially when for this structure one can approach the nodular form which graphite takes in malleable cast irons as a result of annealing."

More recently, Nipper[11] wrote, with reference to the optimum morphology of graphite, "A small number of large spheres of graphite would so weaken the matrix at these isolated points that fracture would be easily produced. A very large number of small spheres with a highly dispersed distribution would lead to very great discontinuity of the matrix. The best solution lies between these two extremes. The graphite should have the most favourable type of surface, that is, it should be in short lamellae, thick and not too closely together one with the other."

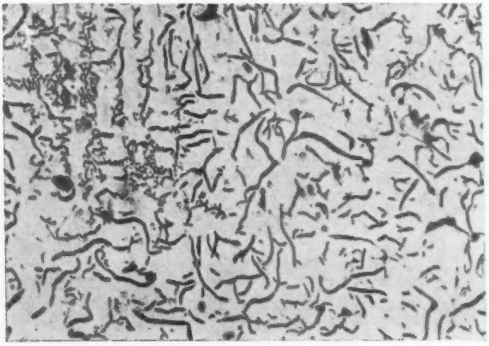
It is desirable to point out, in passing, that the nodular form of the graphite, obtained with white heart malleable or black heart malleable irons, can also be obtained with certain pearlitic cast irons which are chill cast and subjected to a graphitising anneal.

Graphite is also obtained in the form of islets, made up of short lamellae bunched together in the case of certain grey irons with a very low carbon content. The microphotograph of Fig. 3 shows the structure of a grey iron with the percentage composition:—T.C, 2.72; Gr, 2.02; Si, 2.39; Mn, 0.56; S, 0.04; and P, 0.08.

In a general way, even under the best conditions, a grey iron is not to be recommended for applications involving tension, owing to the presence of lamellar graphite, especially when it is appreciated that, in practice, purely tensional stresses are almost always replaced by fatigue under repeated stress.

Influence of Matrix Structure

As regards the matrix, it is particularly the hardness and shear strength which vary with the nature of the composition. These two properties increase directly with the proportion of pearlite in the matrix. In particular, the Brinell hardness increases from about 110 to 120 for a completely ferritic cast iron to about 220 to 230 for a completely pearlitic iron, such as that shown in Fig 1 (c) or in Fig. 3. Obviously, the mechanical properties of white or mottled irons are very different from those of grey irons, especially if machinability be grouped with the mechanical properties, for irons containing free pro-eutectic cementite are practically unmachinable.



(*a*) Unetched. × 100.

FIG. 3.—GRAPHITE IN CAST IRON IN GROUPS OF SHORT LAMELLÆ. × 1,000, ETCHED IN NITAL.

(*b*) Nital Etched. × 200.

FIG. 4.—STRUCTURE OF COMPLETELY PEARLITIC CAST IRON.

Resistance to Attrition

The resistance to frictional wear and to tearing, metal to metal, which is of particular importance in the case of grey irons, depends upon both the graphite and the matrix.

According to F. G. Sefing,[12] if it is desired to set up a range of cast iron structures of decreasing values for friction resistance the order would be as follows:—

(1) Structure wholly pearlitic, fine, containing lamellar graphite, uniformly distributed, which corresponds closely to a eutectic cast iron with the composition: T.C, 3.50; Si, 2.20, with the micrographic structure shown in Fig. 4, and (2) similar structure, with the pearlite less closely laminated; (3) pearlitic cast iron, but with the matrix containing a small proportion of free ferrite (Fig. 5). The graphite lamellae of the same as in types 1 and 2 above; (4) pearlitic cast iron containing a small quantity of free cementite, along with graphite lamellae (Fig. 6); (5) cast iron containing graphite lamellae but with a matrix containing a high proportion of ferrite (Fig. 7); (6) cast iron containing together a high proportion of cementite and graphite in any form (Fig. 8); (7) cast iron of dendritic ferrite, with eutectiform graphite in the interdendritic spaces (Fig. 9).

It should be added that the intercellular network of disconnected phosphide eutectic, which is formed on solidification with hypo-eutectic cast iron with a pearlitic matrix containing from approximately 0.30 to 0.50 P, improves still further the resistance to friction (Fig. 10).

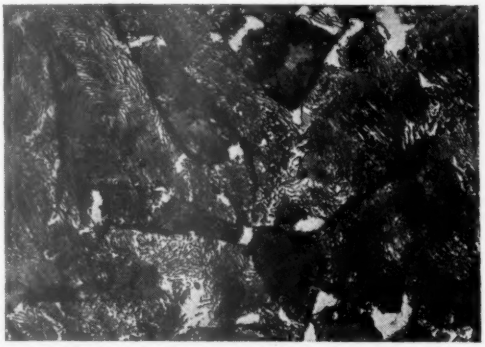


FIG. 5.—PEARLITIC CAST IRON WITH TRACES OF FREE FERRITE. × 200, NITAL ETCHED.

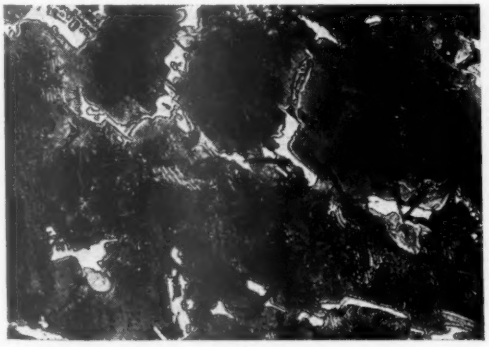


FIG. 6.—PEARLITIC CAST IRON WITH SOME FREE CEMENTITE. × 200, NITAL ETCHED.

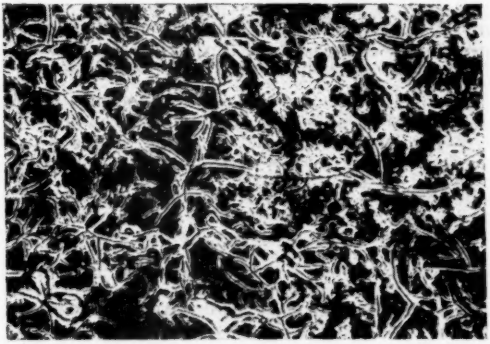


FIG. 7.—GRAPHITIC CAST IRON CONTAINING A HIGH PROPORTION OF FREE FERRITE. × 20, NITAL ETCHED.

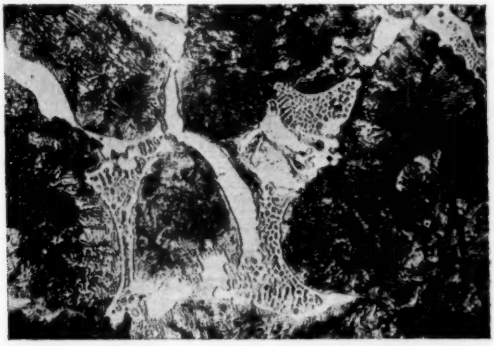


FIG. 8.—CAST IRON CONTAINING HIGH PROPORTION OF GRAPHITE AND CEMENTITE. × 200, NITAL ETCHED.

Structural Diagrams for Cast Iron

THE CHOICE OF A CAST IRON FOR A GIVEN PURPOSE

It is known that the micrographic structure is determined by three sets of factors:—(1) Those relating to chemical composition; (2) those which determine the law of cooling, that is, the continuous curve "temperature-time" of the alloy from the liquid state; and (3) those which relate to the presence, or the formation, of germs or nuclei of solidification in the liquid metal.

For many founders one of the essential problems is precisely that of fixing beforehand what chemical composition is most suitable for obtaining, from the casting equipment, castings to meet the given conditions, that is, to stand up to, with the best results, the life, the mechanical, physical, and chemical working requirements, fixed beforehand, such as are related to frictional wear, fatigue under alternating stresses, corrosion-resistance, etc.

The first datum of the problem is the design for each casting, particularly the size of the section, which is of prime importance since it is this which governs the law of cooling from the casting temperature of the metal to that of stripping (and consequently the mean speed of cooling in that interval) for a mould of given kind and shape.

The second factor in the problem is the resolving of the characteristics of all kinds which it is sought to obtain in the casting. As has been stated, these tests are in every case the expression on the mechanical, physical, or chemical plane, of the macrostructure and of the microstructure. In order to simplify matters, it is proposed to take the case first where no nuclei of solidification are added to the molten metal, so as to eliminate for the moment the influence of the third series of factors mentioned above.

The problem stated above, namely, "What is the chemical composition required to give specified castings to work under given requirements?" can be put in the more precise form as follows:—What is the chemical composition which is suitable, within given tolerances, for a given casting to obtain a metallographic structure fixed beforehand, when the law of cooling for such a casting is also determined?

FIG. 9.—CAST IRON WITH DENDRITIC FERRITE AND EUTECTIFORM GRAPHITE. × 200, NITAL ETCHED.

FIG. 10.—HYPO-EUTECTIC CAST IRON WITH NETWORK OF PHOSPHIDE EUTECTIC. × 20.

Here two remarks are warranted:—

(1) The law of cooling of a casting does not depend solely on the factors imposed on the founder. The latter can, for instance, modify, if necessary, the nature of his mould or alter its thermal conductivity; and (2) it follows from what has gone before that, from one point to another of a casting, the mechanical tests can give results of substantial variation and are thus not strictly comparable, contrary to what many founders believe, with the tests obtained on a normalised test piece, whatever it may be.[13]

It is possible to go much further on the way to a simplification and a schematisation of the problem. One can, indeed, as a very first approximation, reduce the chemical composition of cast iron to only two variables, namely, the total carbon content and the silicon content. This is a fundamental point. It is known that an ordinary iron always contains, from the fact of its initial preparation in the blast furnace and from the analysis of all iron ores, at least six chemical elements: iron, carbon, silicon, manganese, phosphorus and sulphur (to which must be added gases in solution or in supersaturation, generally present but in very variable quantities). Synthetic cast irons do not fall outside this rule, since the raw materials necessary for their compounding always contain these elements.

Now, the sulphur is practically neutralised by the manganese, which gives the sulphide, MnS. The excess manganese is generally small and has only little influence on the structure. Also, phosphorus has a very distinct influence, acting independently of the other elements, and it can therefore be isolated and studied separately. It segregates on the boundaries

of the eutectic cells during solidification, and gives birth to a binary or a tertiary eutectic, according to circumstances, which is called "steadite," or phosphide eutectic, with a formula $Fe\text{-}Fe_3P$, or $Fe\text{-}Fe_3C\text{-}Fe_3P$, according to whether the iron contains or does not contain combined carbon.

One can also ignore, at least in this first approximation, the influence of gases, although that of hydrogen can be particularly important. Cast iron can therefore be reduced in essentials to an iron-carbon-silicon alloy and, under these conditions, its composition introduces two independent variables, its contents of carbon and silicon. It is inferred that there is no industrial cast iron without silicon, and, conversely, a synthetic alloy iron-carbon-silicon, behaves generally, when cast and solidified in air, in the same manner as a hematite iron with the same carbon and silicon contents. It can therefore be postulated that in order that an alloy may behave like an ordinary cast iron, it must, and need only, contain iron as a base, plus carbon and silicon in a proportion comprised, for instance, between one and four respectively.

The initial problem can now be re-stated as follows: what percentages of carbon and of silicon must be used to obtain the required structure in a casting which follows, from the moment of casting, a given law of cooling.

However, to take the very simplest case, it can be allowed that the speed of cooling is practically constant during the whole period which elapses between casting and stripping; in other words, one has

$$\frac{\triangle \theta}{\triangle t} = \text{V deg. C. per second.}$$

This uniform speed V depends upon many factors in casting: (1) the initial temperature and thermal conductivity of the metal, and (2) the initial temperature and thermal conductivity of the mould, etc. If one considers that casting conditions are set and constant, it can be admitted that V only depends upon the core sectional thickness of the castings. It is convenient to take a circular section of a cylindrical test-bar equivalent to the actual mean section of the part being cast, as this test-piece, cast individually in green sand, might be expected to follow the same law of cooling as the casting in question. This establishes a link between the casting of definite castings and the usual methods of laboratory control.

In the case of castings which have considerable variations in section, it is possible to frame the law of cooling of these parts by taking two cylindrical test-bars cast in green sand, which will follow respectively the same law of cooling as the largest and the smallest sections of the castings in question. In a general way it is possible, with two test-bars of different diameters cast individually in green sand, to ascertain the law of cooling of the thinnest and of the thickest portions of all the castings produced in green sand in a given foundry. In what follows it is in that sense that the section of castings will be defined.

The initial problem now takes the following form:—What percentages of carbon and of silicon must be adopted to obtain a given structure in a cylindrical test-bar, cast individually in green sand, having a given diameter? In order to resolve the idea, the following problem, for example, can be quoted. What carbon and silicon contents will give a structure with a completely pearlitic matrix in a test-bar 50 mm. diameter, individually cast in green sand?

It is clear that it is not possible to go further in the way of schematisation, that is, in the simplification of the problem.[14] It is, however, essential not to lose sight of the fact that this simplified statement of the problem only forms a first approximation. The section at a given point of a casting is not indeed the only thermal factor which determines the structure at that point for a given chemical composition. It would be necessary to take into account the whole of the cooling curve of the metal from the moment of casting to that of room temperature. Everyone knows, for instance, that often the portions the furthest removed from the runner show a white or a mottled fracture, whereas the rest of the casting is grey, for the same thickness, because the cast metal arrived in the body of the casting at a higher temperature. This defect can be remedied, either by increasing the section of the areas concerned, or by bringing the chilled portion outside the casting by a suitable prolongation (lead-off).[15]

It would also be necessary to study the further question: In what way does the introducion of the usual alloying elements (nickel, chromium, molybdenum, etc.) modify the results obtained with ordinary irons and what is the influence of high gas contents? But if, starting from the most simplified question postulated, the Author suppressed one of the independent variables, and particularly if he omitted the speed of cooling, he would be implicitly admitting that it is possible to determine the structure as a function of the chemical composition alone. This would be a very grave mistake, the gravity of which would lie in the fact that it would be a mistake in the very conception of the phenomena occurring during cooling. This point is to-day universally admitted.

In a more precise, and at the same time more general, form, it can be said that the experimental determination of the structure of a cast iron or of a steel is a kinetic physico-chemical problem, and to treat it as a static physico-chemical one is a fundamental mistake. It follows that if one shows the contents of total carbon and of silicon on two axes of rectangular co-ordinates, the areas obtained relative to the given structures will only be *a priori* valid for the constant speed of cooling ascertained by tests. *A fortiori*, it can be said that one obviously could not put on the same binary diagram the structure obtained with different speeds of cooling; yet this is the mistake which was made by Maurer.

Maurer was a Doctor of Engineering, attached to the firm of Krupps, and, in July, 1924, he published, in the "Kruppsche Monatshefte," the diagram which bears his name.

A diagram which would give directly the micrographic structure of a cast iron certainly answers a universal need of founders, since the ordinary thermal diagrams need, indeed, to be interpreted; they do not give immediate information on structures. On the

Structural Diagrams for Cast Iron

other hand, Maurer's diagram was simple, indeed, too simple (but it was easy to use). It was immediately reproduced in all treatises, it was introduced into technical education and it could be seen reproduced in the pages of many metallurgical and foundry journals.[16] Very quickly the name of Maurer became better known to many founders than those of the savants, of the technicians and of the investigators, who have created scientific metallurgy.

Maurer's Diagram

Before considering this diagram, it would not be amiss to specify in what spirit it is legitimate to criticise it. Whatever may be the errors which spoil the first effort, it is not fair, of course, to criticise it with the object of running it down irresponsibly. This is true all the more when criticism is easy or when other reasons could be adduced other than those of a technical nature. The Author considers that one ought, on the contrary, to appreciate the bringing of a new solution to the problem, since this opens the way to new research and to fresh progress.

One the other hand, from a purely objective standpoint, it is essential to sift critically the first proposed solutions, provided that a character of impartiality is observed on questions of scientific or technical interest, from which one should never depart.

Everyone knows Maurer's diagram, which as reproduced in Fig. 11, such as it appeared in his original

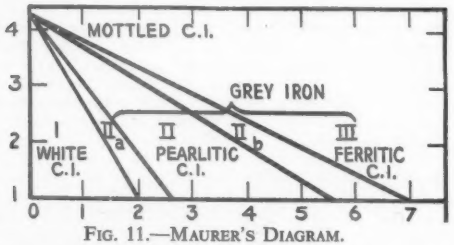


FIG. 11.—MAURER'S DIAGRAM.

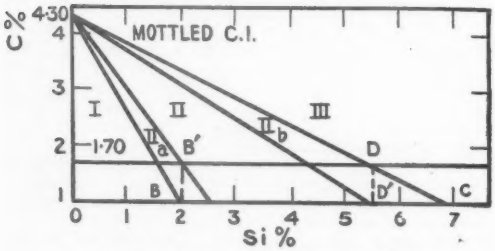


FIG. 12.—METHOD OF DRAWING THE MAURER DIAGRAM, ACCORDING TO AUTHOR'S FIRST DESCRIPTION.

report. If one uses as ordinates the total carbon contents and as abscissæ the silicon contents, each point within the right angle formed by the axes of the co-ordinates corresponds to an iron-carbon-silicon alloy and one only. Reciprocally, every iron-carbon-silicon alloy with given contents of T.C and Si, corresponds to a point, and to one point only, on the diagram, which thus includes all the possible Fe-C-Si alloys.

The micrographic structure of a cast iron would be determined, according to Maurer, by its T.C and Si contents, and the different possible structures would correspond to the areas delimited by converging straight lines intersecting on the vertical axis at the imaginary point of an alloy containing 4.30 per cent. T.C and 0 per cent. Si (Fig. 11).

Under these conditions, zone I of Fig. 11 would be the area of entirely white cast irons; zone II that of irons with entirely pearlitic matrices, and zone III that of irons with entirely ferritic matrices. Zones II_a and II_b were, for Maurer, transition zones, the first being that of the mottled irons and the second that of irons with pearlitic-ferritic matrices.

The method of using the diagram is obvious. To know, for instance, first of all, the structure of a cast iron with 3.40 per cent. T.C and 2 per cent. Si, the corresponding point on the diagram is in area II_b. The matrix would therefore be pearlitic ferritic.

The Author insists that in this over-simplified form the question is wrongly stated and the reply given above is meaningless. It is interesting to ask how this diagram was obtained. To quote Maurer himself, here is the translation of the passage in his memoire where he describes the origin of his diagram:—

"In his diagrams of alloy steels, Guillet makes his lines converge towards a carbon content of 1.65 per cent. It ought to be possible to determine an analagous point on the carbon axis of the cast-iron diagram and, from this fact, *I have chosen* the eutectic point at 4.3 per cent. (Fig. 12). On the axis for silicon content, *I have placed* point B at 2.0 per cent. of silicon, because, as the result of my tests on black fracture of steel, I have found that steels with 2 per cent. silicon could be cast, with perfect security, up to a carbon content of 1 per cent., without any separation out of graphite taking place. *I have taken* point C with 7 per cent. silicon from Guillet's diagram for silicon steels.

"By connecting up points B and C with point A (Fig. 12), the three required zones are obtained. The transitional zones II_a and II_b between the three areas are obtained as follow:—Point B *was projected* upwards to the horizontal which passes through the point 1.7 per cent. carbon, since this carbon content is considered to be the limiting point between steel and cast iron. Similarly, point D *was projected* downwards to D′ on the axis of the abscissæ. *B′ and D′ were then joined to point A* so as to obtain the transitional zones."

It is strange to find that Maurer's text is as universally unknown as his diagram is universally known. That is perhaps one reason for the prolonged credit given to this diagram. Metallurgical theorists, and research workers, read into it the extrapolation of lines obtained through a very large number of experimental

(*Continued on page* 203.)

London Conference Discussion

Nodular Cast Irons, their Production and Properties*

General appreciation of a Classic Research

By H. Morrogh and J. W. Grant

The CHAIRMAN (Mr. R. B. Templeton), opening the discussion following the presentation of the Paper in précis form, said he thought the work of Mr. Morrogh and his colleagues was best summarised by a quotation from a paragraph in the Paper which said a new field in the metallurgy of cast iron had been opened which might eventually have tremendous possibilities.

This he endorsed, for he believed the work done would become a classic and a model for research workers in the future. In 1947 there was a Paper on the value of graphite formation in cast irons and nickel-carbon alloys. That Paper had been followed some time earlier in the year by one on the production of nodular graphite in cast irons, a record of the work done on the theories of the earlier Paper, and giving most complete data of the metal compositions, methods of treatment and conditions under which the structures might be produced.

He could not help thinking, and he was sure they all felt the same, that the successful development of that new iron was now up to the industry. He did not think they could have had more complete data than they had been given in the Paper. He congratulated the Authors on their excellent research work.

Upper Phosphorus Content in Nodular Irons

MR. G. W. NICHOLLS said when reading through the Paper the following questions occurred to him. The first referred to page 2 of the preprint, in which it was stated "Irons of the type illustrated in Fig. 1 produced only by the simple addition of cerium, in some form or other, to the molten metal before casting, will usually have a microstructure consisting of a mixture of hyper-eutectic nodules." He asked the Authors whether their use of the word "usually" meant that there were other variables besides those mentioned in the Paper, which prevented the formation of the nodular graphite formations.

The second referred to page 1 of the preprint and also to page 21. To take page 1 first, it was stated therein: "The phosphorus content must not exceed about 0.6 per cent. and should preferably be below 0.1 per cent. On page 21 of the preprint the Authors state that the phosphorus content in excess of about 0.5 per cent. made it impossible to dissolve sufficient cerium in the metal to have the required effect. He would like to be certain what was the exact maximum figure of phosphorus which did prevent the formation.

There were three other questions for the Authors' notice. Was there anything peculiar in the molten metal during casting which necessitated care in running it into a casting? Secondly, what standard of surface finish was obtained on finely machined or ground surfaces? Was there a tendency for the surfaces to be of an open grain? And finally, it was mentioned throughout the Paper that that process undoubtedly would be of an expensive nature. He had been reading the account of the discussion of that Paper in America by the same Authors, when it was mentioned during the discussion that the same structure could be obtained by other alloys. He understood one of them was a nickel-magnesium. Had the Authors any evidence that that was so? He imagined a nickel-magnesium alloy would be a cheaper method of forming nodular graphite compared with cerium, and as an alloy it would be much more consistent in its composition than was Misch-metal.

Increased Sinking Observed

MR. MORROGH, replying, said with regard to their use of the word "usually." They used the word "usually" there because if the alloys were rapidly cooled the effect was to make the hyper-eutectic nodules more finely divided and then they tended to get structures which were 100 per cent. nodular.

With regard to phosphorus content they had not been as precise there as they should have been, but they would appreciate that the statement quoted in the second paragraph gave the principal composition requirements. The composition requirements were stated as rules and not as laws. In connection with the cerium content, they occasionally found nodular irons with a cerium content slightly below 0.02 per cent., but as a general rule the cerium content should be above 0.02 per cent. Similarly, as a general rule the phosphorus content should be well below 0.6 per cent. It was possible to produce nodular structures with phosphorus contents over 0.5 per cent., but it was quite difficult. Phosphorus decreased the solubility of cerium in the metal and the decrease in solubility appeared to be a function of the phosphorus content. Perhaps a fairer way of defining the upper phosphorus content permissible would be 0.5 to 0.6 per cent.

With regard to casting the metal, it had characteristics of its own which required special methods

*Paper presented at the London Conference of the Institute of British Foundrymen, June, 1948, and published in the JOURNAL, July 8, 15, 22, and 29.

Nodular Cast Irons—Discussion

in the foundry. There was no precise way of evaluating the fluidity of cast iron, but in general the treated material was rather less fluid than the untreated material. As far as founding troubles went, the material tended to be much more susceptible to external sinking than ordinary grey cast iron, but experience would overcome those troubles by suitable modifications in running and feeding techniques.

With regard to surface finish, their experience led them to think the surface finish of the nodular irons was very good and in general rather better than that of ordinary grey cast irons.

The use of magnesium for the production of nodular structures he could confirm. There were likely to be other methods developed along the same lines, involving roughly the same principles and perhaps ultimately the industry would find that some combination of all those methods would be the most satisfactory.

He had to disagree with Mr. Nicholls in implying Mischmetal to be inconsistent. It was surprisingly uniform and the composition varied only very slightly.

Growth and Heavy Sections

MR. C. GRESTY said that, although the Paper gave a good deal of information on the properties of nodular cast iron, he still felt a desire to ask for more. For example, there were a few factors which were of vital interest, perhaps even more so than sheer mechanical strength, to certain classes of engineer. Thus, makers of heavy diesel engines would be particularly interested in the resistance of the material to the conditions which give rise to the phenomenon of "growth." The Paper gave a very limited amount of information as to the effect of heat on nodular irons, but there was no indication as to the effect of repeated heating and cooling. If tests of this type had been carried out, he would be glad to know the results.

Also, from the point of view of heavy castings, he would like to know what was the effect of mass on the properties of the material. All the information given in the Paper appeared to have been obtained on test-bars ranging in size from 0.6 in. to 1.6 in. diameter, and, therefore, the maximum weight of any individual casting would be in the neighbourhood of 15 lbs. In view of the importance of mass effect, he would like to ask whether any information was available regarding the properties of the material in castings of, say, 5 tons weight, or more.

Two other points on which he would like some data were:—(1) The thermal conductivity of nodular cast iron in relation to other high-duty cast irons, and (2) the wearing properties under conditions which cylinder liners have to meet in service.

Heat-resisting Properties

MR. MORROGH, dealing with the problem of the heat-resistance of the material, said they found in laboratory tests that when the material was subject to constant elevated temperatures, its resistance to growth tended to be better than un-alloyed grey cast iron, due to the fact that internal oxidation was inhibited. But the small amount of evidence that they had available at the moment tended to indicate that as far as the resistance to thermal shock was concerned, nodular cast irons might be inferior to the untreated material.

With regard to large castings, they must remember that the development was in its initial stages, and they had not had much experience with large castings. But fairly heavy sections up to about 6 in. had been made without any particular difficulty. He was unable to quote any actual mechanical test figures for the heavy sections although, of course, as one would expect, they tended to fall with increasing section size.

He was unable to quote any figures for thermal conductivity. That would have to be a matter for a future publication. With regard to wear, they had not yet had the opportunity of assessing adequately the actual resistance of the material, so he could not offer any comment on it beyond saying that the wear resistance of that material could vary over a very wide range, since they could produce it in the pearlitic, martensitic, or austenitic condition. In addition, at the Association they were not satisfied that there was any form of wear resistance test which could adequately assess the wear resistance of the material. Therefore they were awaiting the results of actual field tests on components before expressing an opinion on them. Further information on that subject would be in the hands of the user and the manufacturer, to a large extent.

Varying Sections

MR. E. HUNTER asked if Mr. Morrogh could give any information on the amount of liquid shrinkage of the metal. It did appear that with this structure the liquid shrinkage would be higher than normal and Mr. Morrogh's remarks on castings showing a tendency to shrinkage rather illustrated this point.

His next point was on the question of the effect of varying section in a casting. He did not refer to the point raised by Mr. Gresty but rather to the question of a sectional change in a single casting where one might have a difference in section of from, say, one to four inches in the same casting. From Mr. Morrogh's Paper it appeared that there was a tendency for some of the smaller bars to show a white structure, and he asked if after the Mischmetal had been added to obtain nodular graphite was it intended to control the amount of graphitisation to suit a varying section by means of a process of inoculation.

His final point concerned heat-treatment. He noticed that the structure was described as being "nodular or flake graphite in a matrix of ferrite or pearlite." He would like to know if, when a casting was subjected to quenching and tempering, Mr. Morrogh had experienced any adverse effect from the amount of ferrite in the original structure.

(To be continued.)

South African Branch Discussion

Repetition Pattern Making*

By K. L. Futter

MR. J. H. WEST (Branch President) congratulated Mr. Futter on his excellent paper and, referring to his statement that aluminium was difficult to solder, stated that this trouble could be overcome by a proprietary mixture now on the market, which could be used with a blow torch.

MR. BULLOCK said that the eutectic welding of aluminium had proved very successful. The material was supplied by a Johannesburg firm and was very good. Two pieces of aluminium could be fixed together without fear of melting either piece, and the joint was as strong as a weld. Welding could be done with either a blow torch or a blow lamp.

Pattern Mounting

MR. JANE said various methods for setting up patterns were employed. For instance, the pattern might be set loosely on two match boards one above the other with the moulding box on top, and the position of the heads would be discussed with the foundry foreman. The pattern was then held down and a scribed line was drawn right round the whole contour. Office or dressmakers' pins were then cut off and knocked in at about 1-inch intervals along the scribed line and the heads cut off, the pins projecting about $\frac{1}{16}$ in. above the board. When a second board was placed on top and then lifted apart, a perfect contour of the top board was obtained. No trouble with cross-jointing was experienced. Another method was to make up a special pair of trammels, one end of the trammel being located directly into the pin hole. With the movable end of the pin a perfect setting up was obtained. He then mentioned two metals he had recently used with success, namely, Cerrobase and Cerrobend. He had been introduced to these materials by South African Airways. They were so tough after casting that they were often used for dies. On cooling there was a slight expansion but no contraction at all. In his opnion, these were the ideal metals for pattern-making.

In reply to a question, MR. FUTTER said that to-day pattern filing was regarded solely as operators' work. Operators were employed on this operation under the supervision of the patternmaker responsible for the particular job. With the size of castings his company produced and the plates capable of accommodating anything from 20 to 60 patterns, they found it far simpler to dowell the particular pattern, mount the pattern in the required position, and drill right through both boards. When the boards were taken apart the dowell holes must match. This was the easiest and quickest method. Mr. Futter emphasised that that type of patternmaking required absolutely accurate equipment. Without suitable machines available it could become very difficult.

A MEMBER recalled a visit he had paid to the Rolls-Royce factory during the war. He had been greatly impressed by the method whereby all the loose pieces were connected up and fell into position in the hollow pattern by the operation of a lever.

Sweating

MR. JANE said that some months ago he experienced considerable trouble with an aluminium pattern, which was inclined to sweat.

MR. FUTTER said that he himself had experienced no difficulties of this nature in his class of work so far as aluminium was concerned, but there had been some trouble with certain brass patterns, and the moulder found it necessary to warm them with a blow lamp to eliminate sweating

MR. JANE stated that large patterns had never caused him any trouble, and MR. FUTTER agreed that size might influence sweating.

MR. BILL maintained that the sweating of a pattern depended almost certainly on whether the pattern castings produced were sound. Sweating was usually attributed to high liquid shrinkage leading to craze on the surface. If the castings were sound they usually gave very little trouble. One of the disadvantages of brass was that unless the castings were sound they were especially liable to sweat. Cast iron was an excellent material from this point of view. The question was also bound up with conductivity. It was fairly certain that alterations in the temperatures of the metals being worked tended to produce sweating. Hot sands and a cold pattern often resulted in sweating, and it was common practice to incorporate some form of heating device. He considered that loose pieces hampered production because they were liable to wear, stick, and get lost, but for particular applications they were an excellent idea. He had seen kaffir pot legs being drawn by a most ingenious method.

MR. WEST said his experience had been very similar. When he had a porous pattern casting he gave it a coating of shellac and rubbed the shellac off again, the object being to fill up the pores. Yet, strange to say, a small brass casting which had been nickel-plated gave the moulder considerable trouble, but after it had been coated with shellac no further trouble was encountered.

MR. BULLOCK pointed out that sweating with a hot sand and cold castings was due to water vapour from the sand condensing on the cold surface of the castings. They should be careful how they used the term "sweating," which often was incorrectly applied. Did not the shellac form a thermal insulation between the pattern and the moisture coming from the sand? He was inclined to consider sweating from that aspect, unless it could be proved that moisture was taken

* Paper presented to the South African Branch of the Institute of British Foundrymen and printed (slightly abridged) in the JOURNAL, August 19, 1948.

Repetition Pattern Making

from the pattern by weighing a pattern in the laboratory, heating it and weighing it again. He suggested that this might be an investigation worth carrying out.

MR. BILL suggested that with hot sand and a cold casting it was very much a question of thermal conductivity.

MR. LINDSAY said that he had been shown a gadget for drying out metal articles before painting. This was an oxy-acetylene torch with which plates were treated to sweat the metal and remove the bloom. This seemed to indicate that sweating was due partly to porosity and partly to condensation.

MR. JAMESON pointed out that, in winter time especially, sand tended to stick to a pattern.

MR. WEST wondered whether Mr. Futter had ever experienced any difficulty in regard to variation of shape and size of the carrier and core box due to contraction.

MR. FUTTER replied that it was necessary to allow for a certain amount of contraction for the carriers, but sometimes the carrier was found to be on the small side or too large.

MR. WEST said that when making multiple boxes, he had sometimes been obliged to throw away the carrier box on account of contraction.

Pattern Coatings

MR. MARAIS wondered if any South African pattern-makers had any experience of a method used overseas of making patterns by electroplating a thin coating of metal over a wax form coated with graphite so as to make the surface conductive. Considerable discussion took place on the applications of this method, which was stated to be particularly suitable for medallions, plaques and similar work. Mr. FUTTER recalled a very large pattern made in hard wood, which had been sprayed with aluminium and stood up to considerable use in the foundry.

MR. BILL was of opinion that the plating method would produce too soft a surface and with heat treatment there would be distortion.

MR. MARAIS said he had seen quite a number of production patterns made with lead.

MR. ANDERSON stated that a 5 per cent. addition of antimony made lead very tough. He asked whether it was possible to get a high finish on patterns which had been aluminium sprayed. He considered that sweating was due to condensation, owing to the fact that it was worse in winter when the temperature of the metal was lower. He found it hard to believe that moisture could be absorbed by ships' plates. There was probably very fine surface moisture on them, and it would be necessary to paint immediately the oxy-acetylene torch had been over them. Did Mr. Futter find it economical to allow patternmakers free access to the pattern milling machine, or did he make that machine the particular responsibility of one man? He was of opinion that a machine of that nature should have the same operator all the time.

MR. FUTTER in reply said that the pattern he mentioned had a very good finish when it came back. If the joints were not smooth they showed up when sprayed. The pattern took the polish well. As regards the pattern milling machine, they had trained one man to be the sole operator because he could adapt himself to the various tools with which it was equipped. Through experience he became very expert with the tools and could do a job in half the time.

MR. BILL mentioned that at one particular foundry overseas, where he had experienced considerable trouble from sticking due to hot sand, he had introduced a spray of linseed oil and paraffin mixed. This gave excellent results but had the great disadvantage that mould contours were not sharply defined, as was the case when using parting powder. Largely for this reason the use of the spray was discontinued. Moreover, the continued use of a sticky material caused a build-up on the pattern, and the labour involved in cleaning patterns was considerable.

Accuracy for Patterns for Pipe Fittings

MR. WARD said he would like to emphasise how difficult it was to get a patternmaker into the swing of comparatively small work. Composite plates brought numerous troubles in their wake, largely owing to the fact that if, say, four different patterns were mounted on the same plate and equal quantities of each were required, one or two patterns might give higher rejects than the others with consequent difficulty in balancing of the order. On the other hand, a short run order could possibly justify the mounting of one pattern as a "fill-up" on an under-filled plate. About 500 patterns were required for pipe fittings, and orders for thousands off would be received. Pipe-fitting patterns call for extreme accuracy. In the first place they had to work to B.S.S. Secondly, they did all their own machining. The jobs could not be bored out before they were threaded. Castings must go into the machine shop and be tapped out at several ends without any preliminary machining whatsoever. They did not deliberately go in for operative labour for pattern filing, but having started from scratch in a new line for South Africa they were faced with a tremendous demand for patterns. They could not get enough tradesmen to keep them in master patterns, filing, etc., and eventually had to get permission from the Industrial Council to use operatives for filing, and these men were paid journeymen's rates.

Special Machines for Patterns

MR. BULLOCK was surprised that no metal milling machines were to be seen in the slides, since these machines would save a considerable amount of filing.

MR. FUTTER said that the universal pattern miller was equipped for doing work on metal patterns, and could cope with both wood and aluminium.

MR. BILL said it was the practice overseas to have a broad division between metal and wooden pattern-makers, the former being termed "filers and chasers." They had actually had a set of patterns chased on a "Keller" profile machine, which was developed during the war for "breeding" other patterns. The chief trouble was the cost of the job. For large jobs the Keller would produce an accurate replica of any given object.

MR. WARD maintained that where a one-off job of a fairly intricate nature with a high degree of finish was required, there was no method to equal the Keller.

MR. WEST suggested that the one disadvantage of metal spraying a pattern was that there was no method of determining whether the metal was evenly spread.

MR. FUTTER said that he had been guaranteed a certain thickness of aluminium. On checking up, the metal was found to be of uniform thickness throughout.

MR. BULLOCK pointed out that each coat of metal sprayed was very thin, so it was an easy matter to keep within a given limit. He maintained that metal spraying produced a porous surface. As an example he mentioned certain cast iron valves which had been sprayed with zinc for protection against corrosion, but which were actually porous.

Structural Diagrams for Cast Iron

(*Continued from page* 198.)

determinations. On the other hand, some founders were perhaps persuaded that this was a logical deduction from theoretical metallurgy.

Be it noted, in passing, that Maurer, in the first place, had actually put forward this one diagram to cover all the structures of all cast irons, or at least "in all normal cases."[17] Moreover, since Maurer himself quotes the diagram of Guillet, relating to the structures of alloy steels, it would seem, incidentally, that it is the search for an analogy with Guillet's diagrams which has led Maurer into error. The Author finds, indeed, the same fundamental errors in those diagrams as he is pointing out here.

(*To be continued.*)

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(*Paper translated by R. W. Allott, M.A.*)

Association Technique de Fonderie

The 22nd annual meeting of the French Association is to be held at 9, bis. Avenue d'Iéna, Paris 16, on October 8 and 9. The following provisional programme has been established.

Friday, October 8

9.15 a.m.—Opening ceremony; speaker, Mr. Pierre Bellier, of the Ministry of Industry and Commerce. The following Papers will then be presented:—"The Risering of Castings," by J. B. Caine (American Exchange Paper); "French Colloidal Clays and Their Application for the Preparation of Synthetic Sands," by P. Nicholas; "Contribution to the Development of the Application of Centrifugal Casting in the Foundry," by P. Lefranc; and "Output Increase of Small and Medium Foundries, Particularly in the Making of Jobbing Castings," by J. Gelain and P. Rigault. This session closes with a film on Swiss foundry apprenticeship methods.

2.30 p.m.—"Study of the Shape most suited for a Magnesium Alloy Casting to Replace a Steel Stamping or Welding," by R. Guastella (Italian Exchange Paper); "The Formulation of Light Alloys of High Magnesium Content," by L. Grand; "Casting of 'Extra' Light Alloys," by A. Gaillon; "The Properties of Aluminium Alloys in the Region of the Solidus," by W. I. Pumphrey (Aluminium Development Association); "Methods of Estimating Certain Impurities in Aluminium," by G. Chaudron; "Hard Spots in Aluminium Alloys," by M. Bardot and G. Duport; and "Observations on the Control of High Duty Light Alloys," by R. Chion.

Saturday, October 9

8.45 a.m.—"Alloyed Cast Irons for Internal Combustion Engines," by R. Chavy; "Influence of the Stripping Temperature on the Graphitisation of White Iron," by G. Joly; "Graphitisation in the Malleable Processes," by H. G. Hall (British Exchange Paper); "Developments in British Foundry Practice, 1939 to 1948," by W. W. Braidwood (Mond Nickel Company); "Inoculation and Graphite in Grey Irons," by Professor de Sy (Belgian Exchange Paper); "Melting Iron in the Cupola During the War Years," by Ove Hoff (Danish Exchange Paper); "Sand Cast Permanent Magnets," by J. Zampach (Czechoslovakia); and "Superficial Modifications of Castings Obtained by Casting in Cement-sand Moulds: Application to Cast Iron," by F. Girardet and H. Guedras.

2.15 p.m.—"The Polish Foundry Research Institute," by K. Gierdjiejewski (Polish Exchange Paper); "The Development of Czechoslovakian Foundries," by A. Plesinger; "The Use of Oxygen in Foundry Practice," by Dr. W. C. Newell (British Iron and Steel Research Association); "The Influence of Composition and Impurities on the Properties of Monel Metal," by Eash and Kihlgren (U.S.A.); "Runners and Risers for Copper Alloy Castings," by Mr. Nixon (U.S.A.); and "The (Paris) Foundry High School Since its Creation in 1923," by G. Rivoire. The closing address will be given by Dr. M. Ballay, the President of the Association.

Pig-iron and Steel Production in Great Britain

The following particulars of pig-iron and steel production in Great Britain have been extracted from the Statistical Bulletin for July, 1948, issued by the British Iron and Steel Federation. Table I gives the production of pig-iron and ferro-alloys in June, with the number of furnaces in blast at the end of the month; Table II, production of steel ingots and castings in June, and Table III, deliveries of non-alloy and alloy finished steel. Table IV summarises steel-industry activities during six months ended June, 1948.

TABLE I.—*Weekly Average Production of Pig-iron and Blast-furnace Ferro-alloys, June, 1948. (Thousands of Tons.)*

District.	Furnaces in blast, 3.7.48	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derby, Leics., Notts, Northants, Essex	26	—	16.2	21.3	1.9	—	39.4
Lancs. (excl. N.-W. Coast), Denbigh, Flints. and Ches.	6	—	7.0	—	—	1.5	8.5
Yorkshire (incl. Sheffield, excl. N.-E. Coast)							
Lincolnshire	13	—	23.6	—	—	—	23.6
North-East Coast	25	8.0	37.3	0.3	—	1.3	46.9
Scotland	9	0.7	11.8	3.1	—	—	15.6
Staffs., Shrops., Worcs., and Warwick	8	—	8.7	1.4	—	—	10.1
S. Wales and Monmouthshire	8	4.1	19.2	—	—	—	23.3
North-West Coast	6	13.6	—	—	—	0.1	13.7
Total	101	26.4	123.8	26.1	1.9	2.9	*181.1
May, 1948	102	27.2	125.4	27.2	1.1	2.8	183.7
June, 1947	91	20.1	98.0	22.8	1.4	2.0	144.3

TABLE III.—*Weekly Average Deliveries of Non-alloy and Alloy Finished Steel. (Thousands of Tons.)*

Product.	1947 (53 weeks).	1948 (1st 6 months).	1947. June.	1948. May.	1948. June.*
Non-alloy Steel:—					
Heavy rails and sleepers	7.6	9.1	10.4	7.8	10.3
Heavy and medium plates	31.6	37.3	36.5	37.6	38.3
Other heavy products	31.8	35.3	34.6	34.8	35.9
Light rolled products (excl. wire rods and alloy-steel bars)	49.7	56.4	53.1	53.1	57.1
Ferro-concrete bars	3.2	3.9	3.0	3.5	4.5
Cold-rolled strip	4.6	4.7	5.1	4.1	4.9
Bright steel bars	4.8	6.1	5.2	5.8	6 6
Sheet, coated and uncoated	24.3	26.6	26.8	25.4	27.3
Tin, terne and black-plate	12.1	13.9	13.8	12.5	14.7
Tubes and pipes	13.5	14.9	14.3	14.5	15.1
Wire	10.8	12.4	12.0	12.1	13.4
Tyres, wheels and axles	3.5	3.7	3.2	3.4	4.0
Forgings	5.0	5.8	4.4	5.3	6.9
Castings	3.0	3.5	3.1	3.3	3.8
Total	205.5	233.6	225.5	223.2	242.8
Alloy Steel:—†					
Tubes and pipes	0.3	0.5	0.4	0.3	0.3
Bars, sheets, strip and wire	3.7	4.5	3.7	4.6	5.1
Drop forgings	1.3	1.8	1.1	1.7	2.4
Other forgings	0.5	0.5	0.4	0.5	0.5
Castings	0.6	0.7	0.7	0.5	0.7
Total	6.4	8.0	6.3	7.6	9.0
Total U.K. production‡	211.9	241.6	231.8	230.8	251.8
Less Inter-industry conversion	19.2	27.2	18.2	27.7	32.2
Total U.K. deliveries	192.7	214.4	213.6	203.1	219.6
Add deliveries of imported finished steel	2.2	2.6	—	1.9	3.6
Total deliveries of finished steel	194.9	217.0	213.6	205.0	223.2

† Excludes high-speed steel.
‡ Includes finished steel produced in the U.K. from imported ingots and semi-finished steel.

TABLE II.—*Weekly Average Production of Steel Ingots and Castings in June, 1948. (Thousands of Tons.)*

District.	Open-hearth. Acid.	Open-hearth. Basic.	Bessemer.	Electric.	All other.	Total. Ingots.	Total. Castings.	Total ingots and castings.
			(Basic)					
Derby, Leics., Notts., Northants and Essex	—	—	10.7	1.3	0.2	11.6	0.6	12.2
Lancs. (excl. N.-W. Coast), Denbigh, Flints., and Ches.	1.7	22.5	—	1.2	0.4	24.9	0.9	25.8
Yorkshire (excl. N.-E. Coast and Sheffield)								
Lincolnshire	—	29.7	—	—	0.1	29.7	0.1	29.8
North-East Coast	1.6	56.5	—	0.7	0.5	57.8	1.5	59.3
Scotland	5.0	37.4	—	2.2	0.7	43.5	1.8	45.3
Staffs., Shrops., Worcs. and Warwick	—	14.3	—	0.7	0.9	14.4	1.5	15.9
			(Basic)					
S. Wales and Monmouthshire	9.5	45.6	5.5	0.9	0.1	61.3	0.3	61.6
Sheffield (incl. small tonnage in Manchester)	9.1	21.4	—	8.2	0.7	37.6	1.8	39.4
			(Acid)					
North-West Coast	0.3	2.7	4.6	—	0.1	7.6	0.1	7.7
Total	27.2	230.1	20.8	15.2	3.7	288.4	8.6	297.0*
May, 1948	27.3	228.1	20.2	13.7	3.4	284.8	7.9	292.7
June, 1947	25.0	196.4	17.0	12.3	3.3	246.5	7.5	254.0

* Five Weeks.

(*Continued at foot of facing page.*)

Personal

MR. THOMAS G. EDWARDS, secretary of the Burntisland Shipbuilding Company, Limited, who has retired after 30 years' service, has received a presentation to mark the occasion.

MR. NORMAN ELCE has been appointed assistant chief mechanical engineer of the Metropolitan-Vickers Electrical Company, Limited. He joined the organisation as a college apprentice in 1920.

MR. CYRIL WATTS, general manager and a director of Richard Thomas & Baldwins, Limited, is to retire from the former office on September 30, but will retain his seat on the board of the company.

MR. ADAM BRYSON and LT.-COL. JAMES F. H. HOULDSWORTH have joined the board of Scottish Non-Ferrous Tube Industries, Limited, Glasgow. Lt.-Col. Houldsworth has been appointed chairman of the company.

MR. C. W. SPERRING has been appointed chairman of Hunter-Penrose, Limited, printers' engineers, of Wellingborough, in place of MR. E. S. HUNTER, who has resigned. MR. B. V. MILLER has been elected to the board of the company.

MISS FLORENCE HANCOCK and MR. C. R. DALE have been appointed members of the Industrial Injuries Advisory Council in place of DAME ANNE LOUGHLIN and MR. F. WOLSTENCROFT, who have resigned because of pressure of other work.

MR. J. T. EDWARDS, joint managing director of the Park Gate Iron & Steel Company, Limited, Rotherham, whose family has an association of more than 100 years with the company, has received presentations in recognition of his 50 years' service with the firm.

MR. GEORGE CLARK, chairman of the Bryan Donkin Company, Limited, plant engineers, ironfounders, etc., of Chesterfield, has been discharged from hospital, where he had been for the previous five weeks. Mr. Clark, who is 87 years of age, underwent an operation.

MR. H. E. DIXON, who joined the British Welding Research Association early this month, is investigating the spot welding of aluminium alloys at the Association's research station at Abington, near Cambridge, in collaboration with Mr. T. M. Roberts. Mr. Dixon had been a member of the Steelmaking Division of the British Iron and Steel Research Association.

MR. W. D. PUGH has been appointed managing director of the Darlington Forge, Limited, in place of MR. F. PICKWORTH, who continues as chairman. MR. W. S. SCOTT and MR. H. G. GRADWELL have been appointed directors of the company. Mr. Pugh, who is an executive director of the English Steel Corporation, Limited, the parent company of Darlington Forge, will act on behalf of the corporation; Mr. Scott, who was a special director and superintendent, becomes works director, and Mr. Gradwell, special director and sales manager, becomes commercial director.

MR. W. TYRER has retired from the active employ of Walker Bros. (Wigan), Limited, engineers and ironfounders, after an uninterrupted period of service of over 55 years, representing the whole of his working life. After serving his apprenticeship he became a fitter and erector and later was responsible for the erection of many kinds of mining machinery both at home and abroad. His advice was valued by many mining officials. His last position with the firm has been that of chief superintendent. Although he has retired from active employment, he will continue to visit collieries and works on behalf of Walker Bros.

British Exhibition in Copenhagen

The British Exhibition in Copenhagen from September 18 to October 3 will be the occasion of the largest and most comprehensive display of British goods ever held in Denmark or Scandinavia. The exhibition is organised by the British Import Union of Copenhagen in co-operation with the Federation of British Industries and with the approval of the British and Danish Governments. It covers more than 100,000 sq. ft. of floor space. More than 1,000 British firms will be represented.

It is officially announced that King Frederik of Denmark will open the exhibition and that the Duke and Duchess of Gloucester have accepted King Frederik's invitation to attend the opening ceremony.

PIG-IRON AND STEEL PRODUCTION IN GREAT BRITAIN (*Continued from previous page.*)

TABLE IV.—*General Summary of Pig-iron and Steel Production.* (*Weekly Average in Thousands of Tons.*)

Period.	Iron-ore output.	Imported ore consumed.	Coke receipts by blast-furnace owners.	Output of pig-iron and ferro-alloys.	Scrap used in steel-making.	Steel (incl. alloy).			Steel stocks.†
						Imports.‡	Output of ingots and castings.	Deliveries of finished steel.	
1938	228	89	—	130	118	16	200	—	—
1946	234	115	169	149	147	8	244	192	1,068
1947 (53 weeks)	209	130	165	147	145	8	240	195	797
1948—January	239	154	196	168	169	4	281	208	777
February	246	164	198	176	174	5	289	221	749
March*	243	169	192	179	175	7	291	219	780
April	247	169	200	181	178	7	294	225	793
May	239	173	202	184	175	4	293	205	846¶
June*	257	171	206	181	180	8	297	223	885

* Five weeks. † Stocks at the end of the years and months shown. ‡ Weekly average of calendar month. ¶ Revised.

Company News

(Figures for previous year in brackets.)

Walker Bros.—Dividend of 7% (same).

Fisher & Ludlow—Dividend of 20% (same).

Range Boilers—Interim dividend of 5% (same).

Sidney Flavel & Company—Interim dividend of 3¾% (nil).

Halesowen Steel Company—Interim dividend of 5% (same).

Dobson & Barlow (Securities)—Dividend of 10⅜% (same).

Herbert Terry & Sons—Interim dividend of 10% (same).

English Electric Company—Interim dividend of 4% (same).

Silentbloc—Final dividend of 16⅔%, making 29⅛% (same).

Josiah Parkes & Sons—Interim dividend of 4% (same).

Bristol Industries—Final dividend of 10%, making 15% (same).

Dawnays—Final dividend of 12½% (same), making 22½% (20%).

Head, Wrightson & Company—Final dividend of 6% (7%), making 10% (same).

Nico Light Engineering Company—Dividend of 10% and bonus of 5% (same).

Manley & Regulus—Final dividend of 10% and bonus of 10%, making 25% (same).

Cheswick & Wright—Gross profit for the year to May 31, £37,983; net profit, after taxation, £13,899; dividend of 80% on the 1s. units; forward, £20,153. The shares were introduced to the Manchester Stock Exchange in August, 1947, and arrangements are in hand for a quotation on the London Stock Exchange.

Hunter-Penrose—Profit for the year to March 31, £114,129 (£100,611); to tax, including tax on current profits, £60,250 (£62,800); general reserve, £30,000 (£10,000); 7½% preference dividend, £1,856 (same); 5½% preference dividend, £1,115 (£956); final ordinary dividend of 20%, making 30% (same); forward, £39,796 (£34,202).

S. P. Austin & Son—Trading profit for the year ended April 30, £84,754; investment income, £1,951; to directors' remuneration, etc., £5,850; depreciation, £4,920; debenture interest, £2,800; reserve for income tax, £29,800; profits tax, £8,800; net profit, £34,535; tax overprovided, £8,000; to general reserve, £37,000 (£3,500); staff pension reserve, nil (£1,500); dividend of 10% (same); forward, £2,276 (£2,241).

James Howden & Company—Profit to April 30, after interest, depreciation, directors' fees and all expenses of management, £260,145 (£257,932); to tax, £135,000 (£185,000); deferred repairs, £7,000 (nil); general reserve, £60,000 (£30,000); written off goodwill, £10,000 (nil); written off patents, £693 (nil); final dividend of 22½ per cent., making 30 per cent., on larger capital (same); forward, £36,861 (£34,454).

Parmiter, Hope & Sugden—Trading profit for the year ended March 31, after expenses, £83,180 (£56,340); E.P.T. recoveries, nil (£5,344); to depreciation, £2,341 (£2,220); directors' emoluments, £7,795 (£7,971); taxation, £38,235 (£27,133); deferred repairs, nil (£5,570); capital increase expenses, nil (£800); profit, £34,809 (£17,990); to general reserve, £25,000 (£5,000); dividend of 30% (same); forward, £59,847 (£59,741).

Qualcast—Accounts for the year ended June 30 (subject to audit) will show record profits and turnover, but in accordance with the decision made in March following the Chancellor's dividend limitation appeal, the board states that it will not recommend a final ordinary dividend for the year in excess of the rate of 40% paid in 1947. To enable the company to comply with the requirements of the new Companies Act the annual meeting will this year be held in the latter part of October, and not in September as in previous years.

Hackbridge & Hewittic Company—Group trading profit to March 31, £176,722; other income, £1,509; to auditors' remuneration, £750; directors' emoluments, £16,500; depreciation, £18,486; bonus to employees, £10,000; taxation, £79,500 (£38,200); net profit, £52,995 (£38,923); to profit retained by subsidiary, £1,293; general reserve, £15,000 (£10,000); preference dividend, £7,700; ordinary dividend of 12%, £26,400 (previous year's 6% not comparable in view of amalgamation and capital organisation in March, 1947, when the company was made public); forward, £27,055 (£24,453).

Metal Industries—Consolidated profit and loss for the year ended March 31 shows trading profits of subsidiaries, less trading losses, £677,335 (£309,222); dividends from investment in British Oxygen Company, £185,000 (same); other sundry credits, making £863,741 (£496,521); to depreciation, £93,810 (£74,195); profits tax and income tax on profits, £220,317 (£87,524); tax on interest and dividends, £94,019 (£84,294); directors' remuneration, etc., £51,300 (£51,257); head office expenses, £736 (£27,701); audit fees, £2,322 (£1,824); net balance, £301,237 (£169,726); less £7,777 transferred to capital reserve, being proportion of profits earned prior to acquisition; balance brought in £207,453, after the addition of £11,449 profit attributable to previous years less £78,655 transferred to capital reserve, being profits earned prior to acquisition; parent company's allocations: 5% preference dividend, £13,750 (same); 3¾% second preference dividend (from date of issue to end-December, 1947), £21,914; provision for further three months' dividend to March 31 last, £7,734; interim dividend of 3% (same) on "A" and "B" ordinary stock, £40,448 (£35,475); final ordinary dividend of 7%, £94,380 (same); subsidiaries allocations: preference dividends, £1,796; to general reserve, £20,000; attributable to outside interests, £21,668; forward, £279,223, comprising £194,520 on parent company's account and £84,703 subsidiaries.

News in Brief

ENGLISH ELECTRIC COMPANY, LIMITED, has received an order for two 60,000-kw. turbo-alternators for the Ontario hydro-electric system.

WILLIAM GRAY & COMPANY, LIMITED, West Hartlepool, has received an order for a motorship of 12,500 tons dw. for Norwegian owners.

RAPAX, LIMITED, Sheffield, is now manufacturing, under licence from the American Chemical Paint Company, Ambler, Pa., "Deoxidine" and "Deoxylyte" acid metal cleaners and "Rodine" inhibitors for pickling controls.

THE MINISTER OF SUPPLY (Mr. G. R. Strauss) is to make his first official visit to Scotland next month. He is to make a three-day tour of Central Scotland, beginning on September 8, to acquaint himself with some of the industries with which his Ministry is directly concerned.

OUTPUT FROM Scottish shipyards in the seven months ended July totalled 66 vessels of 217,659 gross tons. Of this total, 40 vessels of 168,075 tons were launched by Clyde companies, an increase of 8,000 tons compared with the same period of 1947, and 26 vessels of 49,575 tons were launched from the East Coast area, an increase of nearly 10,000 tons over last year's figure.

IF THE LABOUR PARTY nationalised steel, it would be defeated at the next election, declared Mr. Alfred Edwards, M.P. for Middlesbrough East, at a meeting at Newcastle-upon-Tyne. Mr. Edwards, who was expelled from the Labour Party, said that not one member of the party to whom he had spoken and who knew anything about business wanted steel to be nationalised.

LAST OF SIX Newcastle-built generators, each weighing 110 tons, began its six-week rail journey to Birmingham on Saturday. The machines have been built by C. A. Parsons & Company, Limited. The machine is being sent on a specially constructed 56-wheeled cantilever wagon, which needs both up and down lines clear. The average speed of the wagon is 6 m.p.h.

Metal Industries' Ordinary Stock

The directors of Metal Industries, Limited, are proposing that the company's "A" ordinary stock and "B" ordinary stock be consolidated into one class of ordinary stock with equal rights in respect of voting and in all other respects. An extraordinary meeting will be held in Glasgow on September 8 at which resolutions giving effect to these proposals will be submitted. Holders of the new ordinary stock will have the right of one vote for each £1 of stock held. At present voting rights are eight votes per £1 "A" ordinary stock and one vote per £1 "B" ordinary. The "A" and "B" stock rank equally for dividends.

The directors also propose to increase the authorised capital from £4,750,000 to £7,500,000 by the creation of 2,750,000 shares of £1 each. No issue of shares is at present contemplated. The increase in the authorised amount will enable the directors to adjust the capital structure to provide new resources at the appropriate time.

Gazette

HORSTMANN GEAR COMPANY, LIMITED, is being wound up voluntarily. Mr. R. H. Jarritt, Clare Street, Bristol, is the liquidator.

F. L. ATTWOOD, LIMITED, metal rollers, of Birmingham, is being wound up voluntarily. Mr. H. R. Whitfield, Glyn Street, Vauxhall, London, S.E.11, is the liquidator.

T.H.T. ENGINEERING, LIMITED, is being wound up voluntarily. Mr. A. H. Wintle, 27, Market Place, Reading, Berks, is the liquidator. All creditors will be paid in full.

MR. A. W. HUNTER, 185-188, High Holborn, London, W.C.1, has been appointed liquidator (with a committee of inspection) for the voluntary winding-up of the Eralite Manufacturing Company, Limited, precision engineers, of Wimbledon, London, S.W.19.

THE PARTNERSHIP BETWEEN Reginald John Cunningham and William Michael Sorfleet, carrying on business as general engineers, etc., at 170, Park Road, Liverpool, under the style of Cunningham & Sorfleet, has been dissolved. Debts will be received and paid by R. J. Cunningham, who continues under the style of R. J. Cunningham.

THE PARTNERSHIP BETWEEN Herbert Phillips, Maurice Holmes, Frank Albert Polding, Richard Frederick Polding and Edgar George, carrying on business as engineers at 237, Acton Lane, Chiswick, London, W.4, under the style of Automatic Controls, has been dissolved. Debts will be received and paid by M. Holmes, F. A. Polding, R. F. Polding and E. George.

Shipbuilders' Steel Allocations

Sir M. Stephen's Comments

Speaking at Glasgow after the launch of the Cumberland, an 11,300-ton cargo motorship, Sir Murray Stephen, chairman of Alexander Stephen & Sons, Limited, said that one of the shipbuilders' chief difficulties was steel. There they seemed to have become the target of an underground propaganda which put about what might seem at first plausible arguments why the shipbuilding industry should get less steel. One of the most persistent was that because ships were taking longer to fit out owing to the late delivery of some piece or other of auxiliary machinery, the cure was to reduce the amount of steel available and build fewer ships.

Nothing could be more calamitous for the shipbuilders, the shipowners and the country, said Sir Murray. The fitting-out time would not be lessened, since most of the items causing delay were late owing to the calls of other industries on the supplies. The consequences of a further slowing down of shipbuilding would be an increase in costs and inefficiency. To do so would be to play with fire and to jeopardise an export industry which at the moment was turning out in this country more than half of the world's production of ships. Moreover, it looked as though some, at least, of the bottlenecks which had been troubling them were improving, he said.

Increases of Capital

Details of capital increases have been announced by the following companies:—

DEHYDRATION EQUIPMENT, LIMITED, London, S.W.19, increased by £4,000, in £1 ordinary shares, beyond the registered capital of £1,000.

J. W. TAYLOR (ENGINEERING), LIMITED, London, S.W.6, increased by £3,800, in £1 "A" shares, beyond the registered capital of £1,200.

H. & W. ENGINEERS, LIMITED, London, W.1, increased by £5,000, in £1 4½ per cent. preference shares, beyond the registered capital of £10,000.

A. LAWRENCE (CONSTRUCTIONAL ENGINEERS), LIMITED, Cardiff, increased by £2,000, in £1 ordinary shares, beyond the registered capital of £1,000.

ROUND OAK STEEL WORKS, LIMITED, Brierley Hill, Staffs, increased by £250,000, in £1 ordinary shares, beyond the registered capital of £600,000.

CROWBOROUGH ENGINEERING WORKS, LIMITED, London, E.C.2, increased by £2,200, in 1s. ordinary shares, beyond the registered capital of £9,000.

STEELBAK, LIMITED, engineers' agents, etc., of London, E.C.4, increased by £24,900, in 99,600 ordinary shares of 5s. each, beyond the registered capital of £100.

H.A.B. & COMPANY, LIMITED, engineers, of West Ealing, London, W.13, increased by £3,000, in £1 unclassified shares, beyond the registered capital of £2,000.

ARTHUR LEE & SONS (COLD STRIP), LIMITED, steelmakers, of Sheffield, increased by £74,900, in £1 ordinary shares, beyond the registered capital of £100.

ARTHUR LEE & SONS (HOT ROLLING MILLS), LIMITED, steelmakers, of Sheffield, increased by £59,900, in £1 ordinary shares, beyond the registered capital of £100.

R. A. LISTER & COMPANY, LIMITED, ironfounders, etc., of Dursley, Glos, increased by £300,000, in £1 ordinary shares, beyond the registered capital of £1,300,000.

EDDLESTONE & COMPANY, LIMITED, mill furnishers, engineers, etc., of Padiham, increased by £24,000, in £1 ordinary shares, beyond the registered capital of £6,000.

RICHARD BECKWORTH, LIMITED, general engineers, etc., of Yiewsley, Middx, increased by £4,000, in £1 ordinary shares, beyond the registered capital of £1,000.

LONDON ENGINEERING COMPANY, LIMITED, agricultural engineers, etc., of Loddon, Norfolk, increased by £8,000, in £1 shares, beyond the registered capital of £12,000.

FOX & OFFORD, LIMITED, mechanical and electrical engineers, etc., of Birmingham, increased by £10,000, in £1 ordinary shares, beyond the registered capital of £20,000.

DRIVER-ADAMS SERVICES, LIMITED, manufacturers of fish-frying ranges, etc., of Redcar, Yorks, increased by £500, in £1 ordinary shares, beyond the registered capital of £1,000.

SANDHOLME IRON COMPANY, LIMITED, Todmorden, Yorks, increased by £10,000, in 1,550 preference and 8,450 ordinary shares of £1, beyond the registered capital of £10,000.

VULCASCOT (GREAT BRITAIN), LIMITED, manufacturers of machinery, tools, etc., of London, N.W.8, increased by £9,900, in £1 ordinary shares, beyond the registered capital of £100.

DERWIL PRODUCTS, LIMITED, manufacturers of and dealers in machinery, tools, etc., of London, S.W.1, increased by £4,000, in £1 shares, beyond the registered capital of £1,000.

MONKHOUSE & BROWN, LIMITED, iron and steel merchants, etc., of Newcastle-upon-Tyne, increased by £5,000, in £1 ordinary shares, beyond the registered capital of £25,000.

PERKIN & COMPANY, LIMITED, engineers, etc., of Leeds, increased by £30,000, in £1 shares, beyond the registered capital of £10,000. All shares have now been converted into shares of £1.

BUTCHER & SON OF DUNMOW, LIMITED (formerly Stansted Agricultural Engineers & Contractors, Limited), Dunmow, Essex, increased by £30,000, in £1 shares, beyond the registered capital of £9,660.

HARLAND ENGINEERING COMPANY, LIMITED, Manchester, increased by £150,000, in 100,000 6 per cent. cumulative preference shares of 10s. and 400,000 ordinary shares of 5s. each, beyond the registered capital of £350,000.

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained.

Galway, September 15—Construction of a water supply scheme, including the provision of pumping plant and supplying and laying 3,715 yds. of 4-in. dia. and 1,110 yds. of 3-in. dia. cast-iron mains, etc., for the County Council. Mr. H. G. O'Connor, consulting engineer, 4, St. Francis Street, Galway. (Fee £10, returnable.)

St. Neots, October 4—Construction of a compressor house, approx. 200 yds. of 6-in. dia. spun-iron pumping main, 40 yds. of 2-in. air main, etc., for the Urban District Council. John Taylor & Sons, engineers, Artillery House, Artillery Row, Westminster, London, S.W.1. (Fee £5, returnable.)

Smallburgh, September 20—(1) Construction of sewage disposal works and two pumping stations; (2) construction of approx. 4,500 yds. of 4-in., 6-in. and 9-in. cast-iron sewer and pumping mains; 4,700 yds. of 6-in. glazed stoneware sewers, and 1,000 yds. of 12-in. dia. asbestos cement sewer, etc., for the Rural District Council. W. Herbert Bateman & Partners, consulting engineers, Halifax House, Bank Plain, Norwich. (Fee £10 10s., returnable.)

South Kesteven, September 22—Supply and laying of approx. 7 miles of spun-iron trunk and distribution water mains, varying in dia. from 12 in. to 3 in.; construction of a storage reservoir of 210,000 galls. capacity; and the erection of a booster station, for the Rural District Council. G. B. Kershaw & Kaufman, consulting engineers, 1, Victoria Street, Westminster, London, S.W.1. (Fee £5 5s., returnable.)

Spalding, September 6—Construction and maintenance of approx. 4,700 yds. of 6-in. dia. spun-iron pipes, etc., for the Rural District Council. Silcock & Simpson, consulting engineers, 10, Park Row, Leeds, 1.

Obituary

MR. CHARLES E. SIDDONS, of Webley & Scott, Limited, engineers and machinists, of Birmingham, has died at the age of 85.

MR. ALLAN MACKENZIE SHAW, formerly of the Clyde Iron Works, of Colvilles, Limited, died in a London hospital on August 14.

MR. W. F. GARNER, Director of the National Association of Drop Forgers and Stampers, died suddenly at his Birmingham home on August 15.

MR. JOHN A. W. H. WHITWAM, who was security officer of A. Kershaw & Sons, Limited, precision engineers, etc., of Leeds, has been killed in a motoring accident.

MR. JOHN ALAN MACKINLAY, proprietor of J. C. Mackinlay & Company, pig-iron merchants, etc., of Wallbrook, London, E.C.4, died on August 17 after being involved in a motor accident He was 63.

MR. GEORGE WILLIAM GIBSON, formerly works manager of Robert Thompson & Sons, Limited, shipbuilders, of Sunderland, which closed down under the scheme of National Shipbuilders Security, Limited, has died. He was 86.

MR. JOHN WILKINSON, of Leith, has died at the age of 76. He was chairman of John Wilkinson (Machinery & Tools), Limited. Mr. Wilkinson had been connected with the business for over 60 years, and was well known throughout Scotland as a licensed valuator on machinery and plant.

MR. W. A. MUSGROVE, who has died at Southport at the age of 77, was a director of the Renishaw Iron Company, Limited, near Sheffield, while he was senior partner of the Manchester firm bearing his name, which has extensive ferrous and non-ferrous interests. The company acts as Lancashire agents for the Renishaw Iron Company's pig-iron and coke. Mr. Musgrove was also managing director and proprietor of R. & J. Smith Bros., Limited, iron, steel and metal stockholders, of Sheffield.

DR. ALAN FARADAY CAMPBELL POLLARD, Professor Emeritus of the Imperial College of Science and Technology, died at his home at Thames Ditton, Surrey, on August 15 at the age of 70. His field of work was the practical application of the principles of physics to the solution of specific engineering problems. Dr. Pollard's practical experience was broadened by work on the technical staff of Siemens and he was for a time chief physicist of Nobels, while during and for some time after the 1914-18 war he assisted in the development of aircraft instruments at the Air Ministry.

MR. J. N. KELLAR, of the Cavendish Laboratory, Cambridge, and secretary of the X-ray analysis group of the Institute of Physics, was killed in an accident in Holland recently. He was on holiday subsequent to attending the Amsterdam conference on "Physics of Metals," and met his death when the wet rigging of a small boat in which he was sailing on a canal fouled a low-hanging electric cable. Mr. Kellar was an extremely active worker, both at the Cavendish Laboratory and for the X-ray group, and will be difficult to replace. At Cambridge he was developing a high-intensity X-ray tube and means of obtaining a very fine X-ray beam about 0.01 mm. in diameter.

MR. JOHN G. GALLOWAY, who had been well known in commercial circles in Edinburgh and Leith for many years, died on August 11. He was a director of M. P. Galloway, Limited, iron and steel merchants, ship, mill and colliery furnishers, of Leith, a company which was founded by his father in 1860. He had also been associated with Primrose & Company, Limited, ironfounders, of Leith, while, in 1918, together with Mr. Henry Robb, he formed the firm of Henry Robb, Limited, shipbuilders, engineers, etc., of Leith. For many years Mr. Galloway was a director of the Glenboig Union & Fire Clay Company, Limited. He was for a long period one of the Governors of Edinburgh Merchant Company, of which he was a former Master. He was a director of the Edinburgh and Leith Chambers of Commerce and a Fellow of the Royal Society of Edinburgh. Mr. Galloway also took an active interest in a number of organisations, including the Boy Scout movement, Leith Hospital, and various golf clubs.

Research Fellowship in Extraction Metallurgy

The establishment is announced of a research fellowship in extraction metallurgy, funds for which have been provided by the Nuffield Foundation. It will be awarded in consultation with the Institution of Mining and Metallurgy and the Royal School of Mines, and will be tenable at the R.S.M. for a period of five years. The funds are sufficient to provide a small specialist staff and the necessary equipment, in addition to adequate remuneration for the fellow. Applicants should have had experience in the initiation and development of research.

Applications, giving details of qualifications and experience and the names of three referees, together with suggestions as to the lines of research it is proposed to follow, should reach the Secretary, Institution of Mining and Metallurgy, Salisbury House, London, E.C.2, by November 30.

Engineering Mission to Canada

Among the passengers in the Mauretania, which left Southampton on Friday, are the 12 members of the British engineering mission which is to tour Canada. The mission is sponsored by the Board of Trade and it will investigate market possibilities, particularly with regard to the heavier types of industrial engineering equipment. Other inquiries will be made with a view to securing a greater volume of exports from the United Kingdom.

Mr. E. H. Gilpin, chairman of the British Food Machinery Manufacturers' Association, and a director of Baker Perkins, Limited, Peterborough, is leader of the party, which consists of businessmen and representatives of the Ministry of Supply and the Amalgamated Engineering Union.

New Patents

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patent)." Printed copies of the full Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The numbers given are those under which the Specifications will be printed, and all subsequent proceedings will be taken.

599,305 YORKSHIRE COPPER WORKS, LIMITED, and CONE, J. R. Draw benches for bars, rods, tubes, and the like.

599,327 BRITISH ALUMINIUM COMPANY, LIMITED, and PULLEN, A. N. D. Surface treatment of aluminium and aluminium alloys.

599,374 BREUER, K. Metal roll-forming machines.

599,434 BENNETT, R. S., and BRIDGE, J. F. Methods of, and apparatus for, effecting forging or other hot working of metals.

599,439 TAMA, M., and TAMA, M. Removal of slag from induction furnaces.

599,449 COMPTOIR INDUSTRIEL D'ETIRAGE ET PROFILAGE DE METAUX. Hot working of metals.

599,463 FOUNDRY SERVICES, LIMITED, STRAUSS, K., FRANCIS, J. L., THOMAS, A. C., and BODDEY, R. F. Joining of sand cores.

599,485 DAVY & UNITED ENGINEERING COMPANY, LIMITED (United Engineering & Foundry Company). Treatment of metal strip.

599,591 PAYNE, W. H. Mountings for electric-arc furnace electrodes.

599,621 COMPAGNIE DE PRODUITS CHIMIQUES ET ELECTROMETALLURGIQUES ALAIS, FROGES & CAMARGUE. Light anti-friction alloy.

599,691 ELASTIC STOP NUT CORPORATION OF AMERICA. Working magnesium and its alloys.

599,694 ALEXANDER, P. Thermal evaporation of metals in a vacuum.

599,725 JENNINGS, H. W. K. (Al-Fin Corporation). Heat-treatment of metal articles.

599,728 WALTERISATION COMPANY, LIMITED, and SHARMA, S. C. M. Processes for increasing the resistance of metals to corrosion.

599,785 WALTERISATION COMPANY, LIMITED, DRYSDALE, R. F., and PARKER, R. W. Processes for the production of protective coatings on the surfaces of metals and alloys.

599,796 STEVENS, A. H. (Electro Manganese Corporation). Electro-winning of manganese.

599,846 UNITED STEEL COMPANIES, LIMITED, and RUSSELL, G. A. V. Firing metallurgical furnaces.

599,848 DELAWARE ENGINEERING CORPORATION. Furnace electrode regulators.

599,849 HOLDEN, A. DE F. Method of and furnace for the heat treatment of metals.

599,857 FASSOTTE, P. C. Bessemer converters.

599,925 COOKE, C. Apparatus for casting metals.

600,561 LOEWY ENGINEERING COMPANY, LIMITED, and LANGEN, M. Method and means for the selective handling of rolled billets.

600,563 ELECTRO METALLURGICAL COMPANY. Growth-resistant cast-iron articles.

600,564 EVERY, C. E. (Titanium Alloy Manufacturing Company). Steel alloys and enamelled steel articles.

600,630 HEUER, R. P. Refractory bricks for use in suspended furnace roofs and other mechanically-supported furnace walls.

600,649 HEUER, R. P. Open-hearth furnaces.

600,650 HEUER, R. P. Suspended furnace roofs.

600,673 WESTINGHOUSE ELECTRIC INTERNATIONAL COMPANY. Heating of strip metal by electromagnetic induction.

600,715 GIBBONS BROS., LIMITED, and MARLE, M. VAN. Heat treatment of metal.

600,716 WATERBURY FARREL FOUNDRY & MACHINE COMPANY. Making nut blanks.

600,729 AMERICAN ELECTRO METAL CORPORATION. Powder metallurgy.

600,797 BENDIX AVIATION CORPORATION. Coating of metals with metals.

600,808 WATERBURY FARREL FOUNDRY & MACHINE COMPANY, and WILCOX, R. L. Trip mechanisms for metal-working machines.

600,829 AMERICAN ELECTRO METAL CORPORATION. Producing sintered, shaped bodies from powdery ferrous material.

600,833 COMPAGNIE DE PRODUITS CHIMIQUES ET ELECTROMETALLURGIQUES ALAIS, FROGES & CAMARGUE. Method of extraction of vanadium from bauxites and manufacture of ferro-vanadium.

600,890 THOMPSON, J. S., and THOMPSON, W. G. Means for securing articles of dissimilar metals and materials to steel bases.

600,914 STANDARD TELEPHONES & CABLES, LIMITED. Apparatus for testing and examining metals.

600,915 STANDARD TELEPHONES & CABLES, LIMITED. Apparatus for investigating surface layers of metals.

600,982 PORTER, J. Method of and apparatus for bending and setting strip, bar, rod and sheet materials.

601,028 FAGERSTA BRUKS AKTIEBOLAG. Method of producing acid Bessemer steel or Thomas steel low in nitrogen.

601,710 BUGATTI, E. Machine for cutting and chamfering metal sheets.

601,713 IMPERIAL CHEMICAL INDUSTRIES, LIMITED, and GATES, W. E. F. Coating of sheet materials.

601,714 SMITH & FAWCETT, LIMITED, and GOSLING, E. B. Apparatus for filling foundry core boxes.

601,715 IMPERIAL CHEMICAL INDUSTRIES, LIMITED, and GATES, W. E. F. Coating of sheet materials.

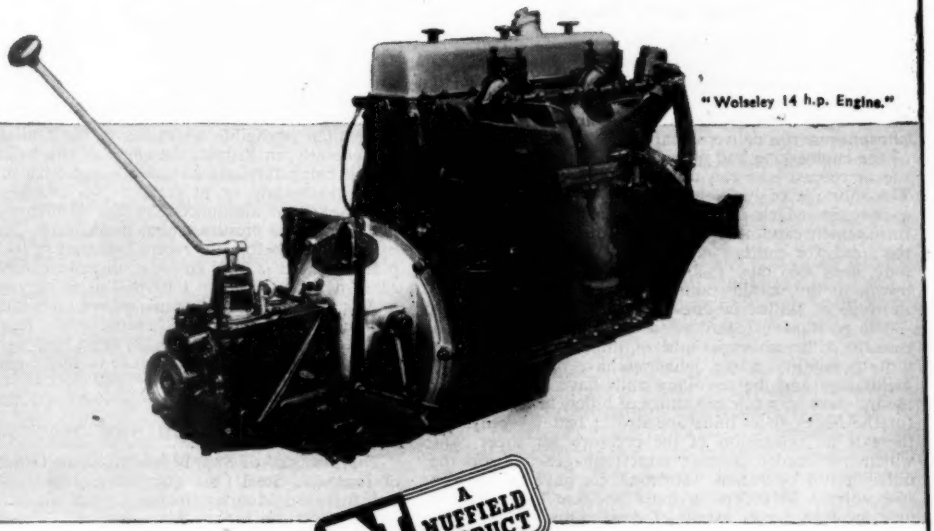
601,735 QUARTZ & SILICE. Electric furnace with carbon resistances.

603,362 SOC. ANON. DES HAUTS-FOURNEAUX ET FONDERIES DE PONT-A-MOUSSON. Method and means for making bell-ended metal pipes by centrifugal casting.

603,429 BUDD WHEEL COMPANY. Induction heating apparatus.

603,446 AIR REDUCTION COMPANY, INC. Method of and apparatus for heat treating thin metal-work pieces.

603,582 COMPTOIR INDUSTRIEL D'ETIRAGE ET PROFILAGE DE METAUX. Hot punching of metals.


"Wolseley 14 h.p. Engine."

A NUFFIELD PRODUCT

Using

STANTON-DALE

REFINED PIG IRON

USED AND RECOMMENDED
FOR ALL HIGH-DUTY
ENGINEERING CASTINGS

THE STANTON IRONWORKS COMPANY LIMITED, Nr. NOTTINGHAM

Raw Material Markets

Iron and Steel

Basic-iron production has now fully overtaken the requirements of the steel plants and the recent starting of an additional blast furnace on hematite has relieved the scarcity of this particular grade. Refined iron is also more freely obtainable and, if medium- and low-phosphorus iron deliveries fall short of the requirements of the engineering and speciality foundries, either hematite or refined iron can usually be used as a substitute. The shortage of high-phosphorus iron, however, poses a problem which is still intractable. Midlands blast-furnacemen cannot cope with the demand and, though the need for putting more stacks into operation has long been obvious, this development is still delayed owing to the scarcity and high price of fuel and the shortage of skilled labour.

The position in regard to semi-finished steel is a little easier. Although expansion of imports remains a remote possibility, home deliveries have been fairly well maintained and the re-rolling mills have restarted after the holidays with fair quantities of billets in hand. Slabs for the heavy sheet mills are also in better supply, but there is no relaxation of the pressure for sheet bars, which are needed in maximum tonnages to keep the mills in full operation. Sheetmakers have an impressive volume of orders in hand and are being offered new business far in excess of their export quotas.

It is a notable fact that, whereas there has been an enormous expansion in steel production this year, exports are restricted to approximately the same levels as in 1947. The authorities still rigidly adhere to the fixed policy of diverting material to the steel-using industries in preference to the direct export of finished-steel products. Thus, there are hopes that the allocations for the fourth period may be increased. Certainly, there is no diminution in the demand for steel, and a steady flow of specifications is maintained. Pressed to enter into further commitments, particularly for new tanker tonnage, shipbuilders are only deterred by the uncertainties in regard to steel allocations, and engineers, power-plant producers, locomotive and wagon builders also have several years' work in hand.

Non-ferrous Metals

The American copper statistics for July, issued by the Copper Institute, show little change in the tempo across the Atlantic, where in all the non-ferrous metals a condition of shortage exists, due partly to an excellent demand by consumers, but also to the effort made by the U.S. Government to implement its stockpiling programme. Production of crude or blister copper in July was 81,237 short tons, against 87,432 tons in June; output of refined copper was 107,014 tons, compared with 105,221 tons in the previous month. Stocks of refined copper rose from 73,065 tons at June 30 to 80,469 tons at the end of July, while deliveries to domestic consumers were 108,309 tons, against 111,927 tons for the previous month. Possibly, the figure for domestic deliveries includes metal destined for the stockpile, but on this point there is no information available. Nevertheless, it is generally assumed that the U.S. Government has managed to amass a certain amount of copper and zinc. It has also presumably achieved some concentration of tin in metal as well as concentrates, and is credited with the intention of putting into store a very large tonnage of this metal, which does not occur in more than negligible quantities in the United States.

Generally, in Britain, the effect of the holiday season is still being felt and business is not very brisk, either in virgin metals or in scrap. No changes in value have yet been announced by the Ministry of Supply and it must be presumed that the Ministry was covered well forward before the recent increases in the U.S. took place. But it is now so long since lead moved to 17½ cents per lb. (£98 per ton) that it is very difficult to understand how sales to consumers in this country have been continued at £90. For some weeks past the price has been not 17½ cents, but 19½ cents, per lb., and even more, for the American users are buying from the Continent.

Increases in Iron and Steel Prices

The Ministry of Supply has made an Order (Control of Iron and Steel (No. 66) Order, 1948), which came into force on Monday, increasing the maximum prices for pig-iron (including blast-furnace ferro-manganese and spiegeleisen), heavy steel products, alloy steel billets and silico-manganese billets, rods, bars and wire.

The increases, which are mainly due to rises in the price of coal, include the following:—Basic pig-iron, 2s. 6d. per ton; hematite (basis prices), 2s. 6d.; foundry and forge, 3s.; low-phosphorus foundry, 3s.; Staffs blast-furnace low-phosphorus, 2s. 6d.; Scotch foundry, 3s.; cylinder and refined, 1s. 9d.; cold blast, 2s. 9d.; refined malleable, 1s. 9d.; blast-furnace ferro-manganese, 3s. 9d., and spiegeleisen, 2s. 3d. per ton. Silico-manganese billets for re-rolling, forging, etc., have increased by 20s. per ton, heavy steel products by 3s. 6d. per ton, and silico-manganese re-rolled bars by 24s. per ton. Prices of semi-finished steel of ordinary quality and of the general run of re-rolled products are unchanged.

Copies of the Order (S.I. 1948, No. 1913) may be obtained from H.M. Stationery Office, Kingsway, London, W.C.2, or through any bookseller, price 1d.

Sir Ben Lockspeiser's Indian Mission

At the invitation of the Government of India, Sir Ben Lockspeiser, chief scientist, Ministry of Supply, is to act as a member of the Quinquennial Reviewing Committee of the Indian Institute of Science, Bangalore, which will sit under the chairmanship of Sir Alfred Egerton, Secretary of the Royal Society, with Dr. J. N. Mukherjee, Director of the Imperial Agricultural Research Institute, New Delhi, as the other member. Sir Ben left for India by air on August 16.